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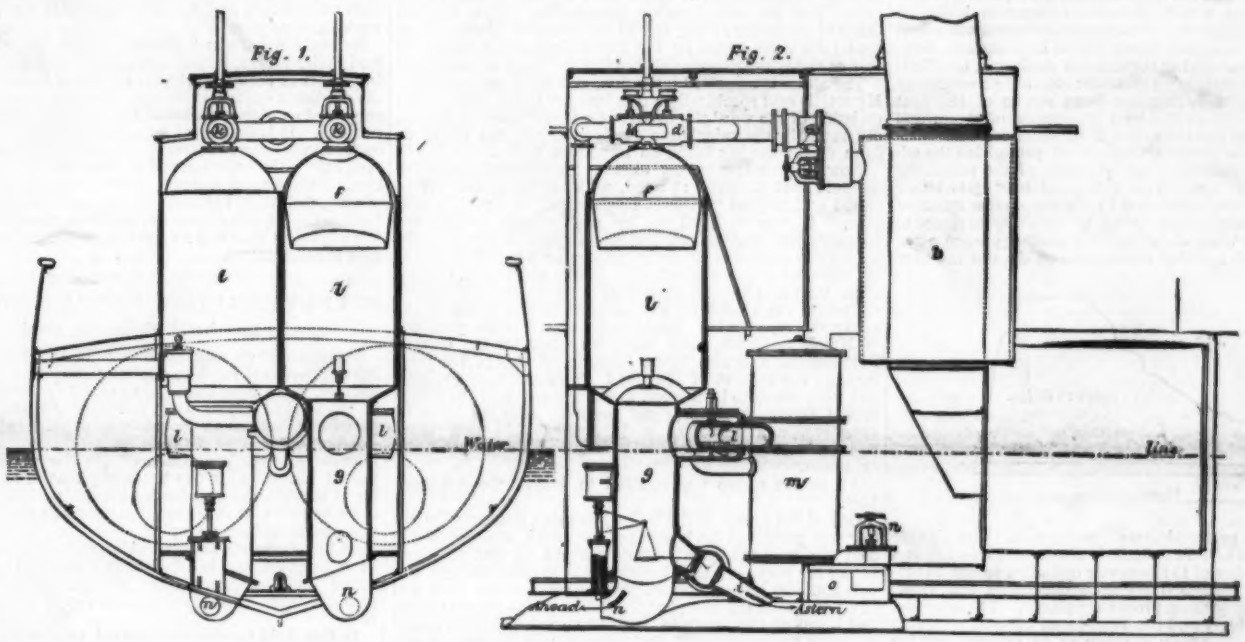
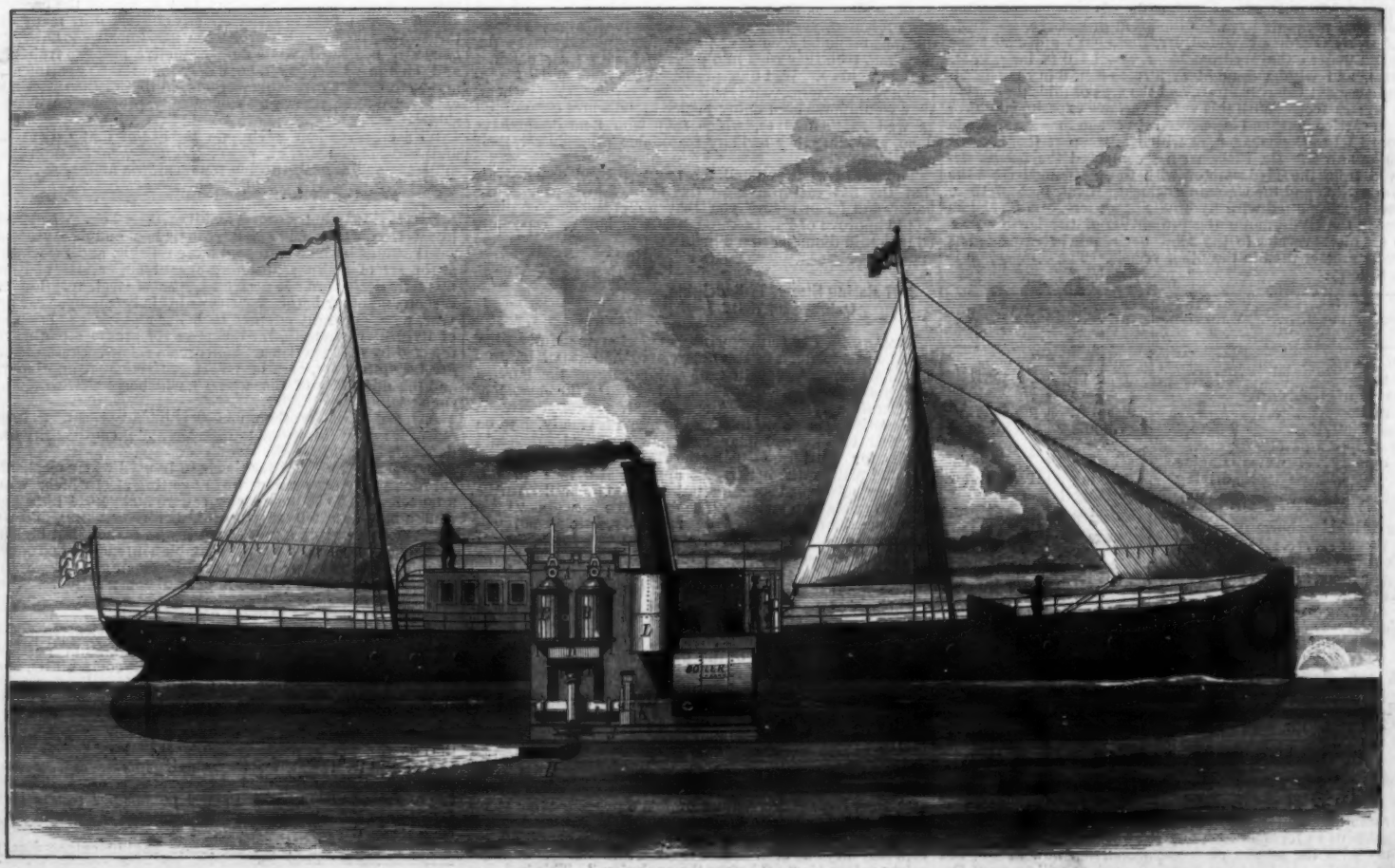
THE HYDROMOTOR.

CONSIDERABLE attention has recently been attracted in Germany to the performances of the Hydromotor, a small vessel fitted with an arrangement of hydraulic propelling apparatus designed by Dr. E. Fleischer, and of which we now annex engravings. In this apparatus—which Dr. Fleischer has named the Hydromotor—the jets of water by which the propulsion of the vessel is effected are obtained by the direct action of steam on the surface of the water to be ejected, no pumps whatever being employed. The whole arrangement will be best understood by reference to the engravings.

As fitted to the hydromotor, the apparatus consists of two reservoir cylinders, *l l*, each furnished with a large pipe, *g*, leading from the bottom of the cylinder to the nozzle, *n*, outside the vessel, as shown. Each cylinder also is provided with a float, *f*, of nearly the same diameter as the cylinder. At *d* and *k* are respectively the steam inlet and the exhaust valves, the latter opening to a pipe which conducts the exhaust steam to the surface condenser, *m*. At *i* is a valve which during the exhaust stroke allows water to flow through the surface condenser into the working cylinder. The steam inlet and exhaust valves just mentioned are worked by means of a rod fixed to the float in the cylinder, there being provided at the top of this rod feathers which work in a grooved bonnet or guide fixed on the top of the cylinder. A second movable bonnet with a curved groove permitting a semi-rotary motion is fitted over the first, and to this upper bonnet are fitted disks or cams which operate the steam and exhaust valves, and effect the cut-off at any desired part of the stroke. The action of this apparatus is as follows:

Confining our attention to one of the reservoir cylinders, let us suppose that it is full of water and the float consequently at the top. In reaching this position the float will have opened the steam valve, and the steam entering the cylinder will press down the float and eject the water beneath it at a great velocity through the nozzle, *n*. The float will thus descend until at a certain portion of its stroke the rod above mentioned will close the steam valve, the expansion of the inclosed steam being then utilized in completing the down stroke and ejecting the rest of the water. Just as it reaches the bottom of its travel the float opens the exhaust valve, when the steam rushes into the condenser, and a partial vacuum being formed in the reservoir cylinder the water rushes in partly through the nozzle, *n*, but principally through the suction valve, *i*, thus raising the float and bringing it again to the top of the cylinder ready for the same cycle of operations to be performed. In the Hydromotor there are, as shown in our engravings,





THE HYDROMOTOR—A NEW STEAM VESSEL PROPELLED BY WATER JETS.

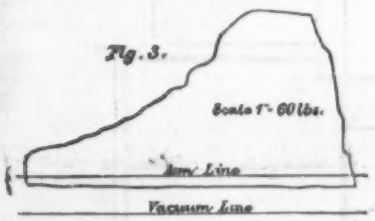
two reservoir cylinders which perform alternate strokes. In larger vessels the number of reservoir cylinders may be multiplied to any desired extent.

If it should be desired to drive the vessel astern, all that is necessary is to admit steam to the top of a small vertical cylinder, shown fixed by the side of the pipe, *g*. The steam thus admitted will cause the piston of the small cylinder to descend, thus sliding down a sluice door in front of the nozzle, *n*, and at the same time through the arrangement of levers and links, shown by dotted lines, opening a valve which allows the water in the reservoir cylinder to be ejected through the passage, *i*.

It may at first sight appear, that in the apparatus we have been describing there must be a great loss of steam by internal condensation in the reservoir cylinders, but Dr. Fleischer assures us that experiment has shown that this is not the case, while the indicator diagrams which have been taken bear out his views. We annex, in Fig. 3, a copy of one of these diagrams, which certainly shows no unusual amount of condensation. This result is due to the facts, first, that each reservoir cylinder is lined with lignum vitæ, so as to present to the steam a surface with a low specific heat, and of bad conductive power, and second, that water heated on its surface conducts heat downward, but very slowly, while the water so heated remains on the surface of the wood during the downward stroke. At one time Dr. Fleischer proposed to employ a layer of oil on the top of the water in the reservoir cylinders so as to lessen the loss of heat by condensation of the steam; but experiment showed that this expedient was unnecessary.

It is evident that in the Hydromotor the expansive force of the steam is used with great directness, while the losses from friction are extremely small, and thus, although it may be much more extravagant in the use of steam per indicated horse power than a good marine engine, driving a centrifugal or other pump, yet the net effect measured by the water ejected may very well—as Dr. Fleischer maintains it is—be exceedingly good. In the diagram which we publish it will be noticed that but a very moderate vacuum is indicated during the exhaust stroke. Where circumstances will admit of the reservoir cylinders being placed high enough, however, a high vacuum during the exhaust stroke can be effectively utilized in raising the water to be subsequently ejected, the outflow during the down stroke of the float being then effected partly by the pressure of steam and partly by the head due to the height of water column.

Dr. Fleischer claims for his system of propulsion the advantages that it facilitates the handling of the vessel, the discharge of the water from either or both jets either ahead or astern being controlled by the simple movement of a lever on the bridge, there being no necessity to signal to the engine room, while the projecting nozzles present nothing likely to foul ropes or wreckage, and do not interfere



with the vessel performing well under sail. The danger from the fracture of screw shafts is also avoided, and as in a large ship a number of the reservoir cylinders would be employed there is comparatively little chance of the vessel being left entirely without propelling power. The wear and tear of the machinery and the quantity of oil used will, it is claimed, also be materially less than in an ordinary marine engine, while the hydromotor has the advantage of affording enormous pumping power in the event of leakage.

As we have already stated, Dr. Fleischer's apparatus has been fitted to the Hydromotor, a vessel 110 ft. long, 17 ft. beam, and with a draught of 6 ft. to 6 ft. 6 in., the mean displacement being 105 tons, and the area of midship section 61 square feet. With this vessel various experiments have been carried out, and a successful voyage has been made from Kiel to Copenhagen, at which latter port the Hydromotor now is. Dr. Fleischer has compared the results derived from the Hydromotor with those obtained from the Waterwitch and the German steamship Rival, both of these vessels being fitted with hydraulic propellers, and he claims that in the Hydromotor the proportion of the horse power in the ejected water to the total horse power expended is vastly greater than in the other vessels. The comparison is as follows:

Name of Vessel,...	Waterwitch.	Rival.	Hydromotor.
Displacement in tons.....	1,279	about 170	105
Area of midship section	—	91 sq. ft.	61 sq. ft.
Speed attained ...	9 3 knots	7 knots	9 knots
Description of machinery..... ...	Engine driving centrifugal pump	Engine driving centrifugal pump	Fleischer's Hydromotor
Indicated horse power.....	760	292	100
Coal consumption per hour.... ...	—	832 lb.	255 lb.
Area of discharge opening	5·38 sq. ft.	3·63 sq. ft.	0·29 sq. ft.
Velocity of discharge of water in ft. per second	30 ft.	23 ft.	66 ft.
Water discharged per minute.....	9,000 cub. ft.	5,000 cub. ft.	700 cub. ft.
Horse power accounted for in the water discharged...	267 H. P.	77 H. P.	89 H. P.
Loss.....	64·9 per ct.	73·7 per ct.	11 per ct.

The data so far available respecting Dr. Fleischer's Hydromotor are not yet sufficiently detailed or extensive to enable us to form a direct comparison of it as regards economy with the system of screw propulsion now in use; but the results obtained are certainly such as will warrant Dr. Fleischer's plans receiving careful attention at the hands of marine engineers. Quite apart from the question of economy, also, the system possesses certain merits of its own which will speedily commend it for use under particular conditions, and altogether we shall watch with much interest the further experiments which we understand it is proposed to carry out. We expect shortly to have more to say on the subject. Dr. Fleischer, we may add, is now in London arranging for the introduction of the system in this country.

The foregoing, with the diagrams, we take from a recent number of *Engineering*. The first accounts of this novel vessel, and the first illustrations made public, were given in the SCIENTIFIC AMERICAN of October 11, 1879. Since that time the machinery has been improved and better results are now obtained. Our view of the vessel is from the SCIENTIFIC AMERICAN of the above date.

MR. LE VAN ON THE GAFFNEY BOILER EXPLOSION.

To the Editor of Scientific American:

On my return to this city last week, I found in your issue of September 3, 1881, the following statement:

"Mr. Barnet Le Van, in the *Franklin Institute Journal*, says:

"A cast iron boiler head only 2 inches thick would not be considered by experienced engineers strong enough for a cylinder boiler 36 inches in diameter; and he recites the damage and loss of life occasioned by the blowing out of such a head at the Gaffney dye works (so much talked about), that had been duly inspected by a steam boiler insurance company, whose inspector he censures by implication because he passed this head without comment, while his own testimony was that his experience had taught him that other forms were stronger than this. It appears, however, that the experience of that same inspector had also taught him that the head in question was strong enough for the pressure allowed, but not for the accidental excessive pressure that occurred at noon, with all the steam valves closed and the safety valves inoperative. This was the cause of the boiler giving out at its weakest place, as its model did when tested by the Philadelphia city inspector to five times the pressure allowed on the head in question."

The above is a garbled quotation, and does me injustice. My article said specifically a cast iron *flat* boiler head. The omission of the word *flat* in this case would make a serious difference in the calculation of its strength, the shape or form of the casting being an important factor.

Now, the statement as to the "accidental excessive pressure that occurred at noon, with all the steam valves closed and the safety valves inoperative," is simply a mistake. It was testified to by one witness before the coroner's jury that he saw the steam-gauge a few minutes before the explosion, and the pointer or hand showed less than 50 pounds per square inch. It was also testified to by other workmen present that none of the safety valves blew off before the explosion; and an examination made of the safety valves, after the explosion, by myself in the presence of Mr. John Overn, chief boiler inspector for the city of Philadelphia, and also in the presence of two of the jurymen, at the request of Thomas I Powers, deputy coroner, and were found to be in good working condition; the valves moved freely in their proper position, showing it to be operative, and therefore it is not possible that there was an accidental excessive pressure at the time of the explosion.

All of the above was testified to before the coroner's jury.

One of the agents of the Boiler Insurance Company in this city was present at the hearing of the above, also one of the firm who built the boiler, and they heard all that was said before the jury, and they had the right to question any witness and also present any facts they saw proper, that had any bearing on the case; but instead of which they sat silent and heard all that was said, without a word of protest in any shape or form, although the hearing was postponed one week to allow all the facts of the explosion being collected and presented, yet they presented none until after the verdict was rendered according to the facts placed before the jury, and then they rush into print to justify their conduct in the premises. Had they presented the facts as they represented they were, with witnesses to substantiate them, they would have been doing justice to the whole community as well as themselves, which they would no doubt have done, providing they had any reasonable grounds for their assertions.

The test of what you call the modle proved conclusively that the flat cast-iron head was the weakest part of the boiler, and I can assure you that no competent engineer would approve of flat cast-iron heads in boilers, especially 36 inches in diameter and 2 inches thick.

Yours respectfully,
W. BARNET LE VAN.

9607 Baring Street, Philadelphia,
October 10, 1881.

REMARKS.—The Gaffney boiler explosion was fully illustrated and explained in the SCIENTIFIC AMERICAN of July 9, and an account of the test of a duplicate of the bursted head was given in our issue of July 30 In the *Journal of the Franklin Institute* for August, 1881, appeared Mr. Le Van's article, which we intended to quote correctly, but on referring to the text it appears that the word *flat* should qualify the word *head*—boiler head—meaning the flat cast iron end plate of the boiler. It appears also that Mr. Le Van has misquoted our quotation, thereby still further mutilating his own article. The difference between "by an experienced engineer," as we read his article, and "by experienced engineers," as the above letter reads, may be considered serious by those of his profession who deny his right to speak for the whole fraternity.

We hope that those of our readers who are familiar with the history of the Witt & Sons boiler explosion and the singular law suit of Henrietta Deitet *vs.* the Hartford Steam Boiler Inspection and Insurance Co., which grew out of it on account of the death of the plaintiff's husband, will not impute sinister motives, read between the lines, or substitute the definite for the indefinite article before the words *experienced engineer* in perusing the original article in the *Journal*. But we do not see very clearly how Mr. Le Van explains the Gaffney explosion in either his original article or in his letter. We know that the safety valves themselves after the explosion "moved freely in their position," but their surroundings were not the same as when mounted for use; their casings were more or less damaged, their stems bent, and levers detached by the explosion; neither is there anything in the evidence relating to their then condition, except that they had been known to stick, and that "none of the safety valves blew off before the explosion." This last fact is put in to prove that the boiler blew up at a pressure less than that at which the valves were set to blow off, and, taken with the testimony which he cites that the gauge indicated "less than 50 pounds" a few minutes before the explosion, is calculated to mislead the reader and mystify the cause of the explosion.

It should be borne in mind that all the steam stop valves on the exploded boiler were closed at the time of the explosion, and that the exploded boiler had, therefore, no steam communication with any safety valves except its own, a fact that Mr. Le Van entirely ignores or purposely omits.

As regards the testimony that the gauge indicated less than 50 pounds a few minutes before the explosion, and the value of such testimony generally, we refer our readers to the late boiler explosion in Jersey City, illustrated Oct. 1, and further explained in the SCIENTIFIC AMERICAN of Sept. 23.

In the coroner's examination it appears that, notwithstanding the solemn oath of one witness that the safety valve always promptly blew off at 75 pounds, and the testimony of other witnesses that it had done so a few days before the terrible explosion, yet the test of the valve by the coroner's agent at the Stevens Institute of Technology, after the explosion, showed that it required nearly 400 pounds per square inch to raise it from its seat. The inference is that somebody was mistaken in this Jersey City case. Was it the coroner's expert and the twelve practical jurymen, or the one interested witness supplemented by a couple of friends who were also in some degree interested in defending the management of the boiler?

In the last paragraph of the above letter Mr. Le Van speaks of what we call a mod*l*e: we called it a mod*el;* he also says, "I can assure you that no competent engineer would approve of flat cast-iron heads in boilers, especially 36 inches in diameter and 2 inches thick." Now, so far are we from being assured by this statement, that we happen to know that engineers who are not only competent as engineers, but exceptionally well qualified afterwards by years of experience as professional boiler inspectors, do regularly approve such boiler heads and consider them safe for the ordinary working pressures.

Messrs. Sidebotham & Powell, proprietors of the Frankford Boiler Works, Philadelphia, have carefully preserved the fragments of both the original exploded boiler head and of the duplicate experimental one, and they may be seen and compared as to the quality of iron and soundness of the two castings. It is the judgment of all practical men who have, so far as we know, expressed an opinion, that if any difference exists, the experimental casting was the weaker of the two. It broke at a pressure of 450 pounds to the square inch when tested with hydrostatic pressure. According to Mr. Le Van the exploded head was less than one-eighth as strong. We advise all who feel an interest in the matter to go and look for themselves.

OUR PROGRESS IN MECHANICAL ENGINEERING.*

By ROBERT H. THURSTON, President.

GENTLEMEN OF THE SOCIETY: It is impossible in the limited time that must be allotted to the President's annual address, to do more than glance rapidly over the broad field of mechanical engineering, selecting for study the more prominent and more important departments, and very briefly noting what is their present state, and how far improvement has progressed during late years. The direction of movement to-day becoming known, and the character of the difficulties presenting themselves being ascertained, the way in which accelerated progress may be rendered possible becomes more easy of detection. In many cases we shall find ourselves able to decide precisely where to look for such progress, and in all directions we shall find our exploration interesting, gratifying, and profitable. We will first examine those departments which supply us with our materials.

In that field to which we are apt to give too little consideration, notwithstanding the fact that it lies at the base of all our work, a field which—formerly cultivated by many of the greatest men that our profession has known—is now too generally neglected, while more seductive but less fruitful, and, on the whole, less immediately important departments are overcrowded with able workers, in that of the materials of construction, we are making steady progress on every side.

We are everywhere giving up the use of that expensive and perishable material, wood, and the weak and brittle minerals, and are substituting for them iron and steel.

STEEL—IMPROVEMENTS AND STRENGTH OF.

Iron is slowly but steadily and inevitably being displaced by steel. Cast iron in small parts is less and less used as steel castings become more and more reliable, and especially as the art of making drop forgings of larger size and in more intricate forms is perfected. Sheet steel, very low in carbon and other hardening elements, is becoming, year by year, more generally adopted in boiler making, not because of its greater strength, for the stronger grades are always rejected by the experienced boiler-maker, but because of the greater uniformity, ease of working, freedom from cinder, and the durability of those grades which are well suited to such use.

A tenacity of *less* than 65,000 pounds per square inch (4,550 kilos on the square centimeter) and great ductility are demanded for this work.

In rods and bars, and for sheets to be used where mechanical forces only are present, we are getting steel which, with a tenacity of 80,000 pounds per square inch (5,624 kilos per square inch), stretch 25 per cent. before breaking, and we are sometimes given a grade very low in carbon, but high in manganese, which has ten per cent. higher tenacity and equal ductility. In fact, we are apparently coming to a *manganese steel* as the metal for use in general construction.

STRONG ALLOYS.

In making alloys I have been able to show the existence of an alloy of copper, zinc, and tin of maximum possible strength, and to point out approximately its composition, and my discovery has been confirmed by other investigators, who have independently hit upon alloys closely related to this "maximum metal," and possessing properties of hardly less value. We now know that by carefully proportioning the constituents, by properly fluxing the alloy, and by special mechanical treatment, we may obtain brasses and bronzes having strengths undreamed of by earlier engineers. Tenacities of from 75,000 to over 100,000 pounds per square inch (5,278 to 7,030 kilos per square centimeter) have already been attained.

The introduction of special alloys having extraordinary

* The President's Annual Address, American Society of Mechanical Engineers, New York meeting, November 3, 1881.

strength and uniformity of composition, as the phosphor bronzes, manganese bronzes, and stereo-metal, indicate that workers in metal are beginning to enter upon the path long since opened to them by scientific research.

MALLEABLE NICKEL AND COBALT.

Dr. Fleitmann's discovery of a method of making nickel malleable and capable of welding, and his similar improvement of commercial cobalt by the use of magnesium, is in itself important, and promises to lead the way to further progress.

In the application of the materials of construction we are learning some exceedingly important facts, the most valuable of which relate to those most "precious" of the metals, iron and steel.

The effect of variation of temperature in the annealing of these metals and in the hardening and tempering of steel has long been known. That annealed and unannealed wire differ widely in tenacity and in ductility, that very "mild" steel and good iron are softened by the very process which gives hardness to steel, are long familiar facts, and it has probably been long known to many engineers that there exists a critical temperature, probably definite and fixed for each grade, at which the hardening of steel occurs. Passing this point in cooling the metal takes on its temper, but variations of temperature on either side that point produce no observable effect on its condition, however rapidly they may take place. This critical temperature has now been identified in certain cases, and may prove to be nearly the same for all steels.

COLD ROLLING.

The process of "cold rolling" has long been known to engineers as an exceedingly valuable method of enormously increasing the strength and elasticity of iron. We have now learned that it is applicable to the soft steels, and I think it will become certain ere long that its full effects may be obtained at any temperature below that critical point which defines the limit of molecular stability, as I have just stated it, in steel.

Lauth's process has been applied with equal success to certain alloys of copper and tin, by Sears, in the United States, and later by Rosetti, in Italy, and very extensively and successfully by Uchatius, in Austria. Tobin has cold-rolled bronzes, approaching the "maximum" alloy in composition, and has attained tenacities exceeding 100,000 pounds per inch (7,030 kgs. per square centimeter).

METALS UNDER STRESS.

The radical distinction which is observable in the behavior of metals under stress, and which leads to their division into what I have proposed to call the iron class and the tin class—in the variation of the normal line of elastic limits by intermitted stress—is becoming generally known. Engineers are beginning to perceive that that exaltation of the normal elastic limit, which is observable in the former class, is probably a valuable quality, one the existence of which may prove to justify the use of smaller factors of safety than have hitherto been thought allowable; and this leads to less expense in stationary structures, and to the elimination, to some extent, of stresses due to the inertia of moving parts in machinery. The conclusion reached by many engineers, that moderate static loads may be sustained indefinitely by iron and steel is also to this extent sustained.

On the other hand we are led to the observance of more than usual caution in the use of metals of the tin class, including most of the brasses and bronzes, and to the use, in such cases, of higher factors of safety than are demanded in constructions of iron and steel.

Preliminary straining to secure an elevated initial elastic limit with relief of internal stress is likely to be of service in the applications of iron and steel, as, *e. g.*, by cold rolling, by "frigo-tension" and "thermo-tension," and by wire-drawing, while it proves to be probably less effective with other metals.

The experiments made for the Prussian Government by Wöhler and Spangenberg during a period of fifteen years, and which have now been concluded eight years, are just becoming known to practicing engineers, and Wöhler's law, Launhardt's and Weyrauch's analyses of results are found valuable checks upon usual methods of proportioning iron parts of structures. It is becoming known that not simply the load to be applied, but the frequency and the method of its application, and the condition of the structure as determined by earlier strains, must be considered in settling upon its dimensions, and upon the magnitude of the factor of safety.

Nevertheless, in ordinary work we find that, as experience has taught us, these quantities are well covered by the factors of safety that have become generally accepted. The great value of these researches, and of the many others of the same kind which have been made in every part of the civilized world, is found to come of the ability now conferred upon the engineer to proportion with confidence parts exposed to exceptionally great and unusually variable stresses.

INSPECTION OF MATERIALS.

Perhaps the most important advance made in the use of materials in engineering has been the general introduction of systematic inspection, and of careful test of all materials used. Such inspection and test is now demanded by every well-drawn specification, and is carried out usually by trained and skillful inspectors.

The Pennsylvania Railroad Company, the Bethlehem Iron Company, and other well-managed establishments have even organized complete departments devoted to the examination and test of all materials offered them, and often find that a single investigation repays the whole cost of the department for a period of years. So essential is that system found to be that I am frequently called upon to advise in regard to new "laboratories" in all parts of the country in which iron, steel, lubricating materials, and other supplies of value are to be systematically examined before purchasing. This is not a mere matter of dollars and cents however. Every engineer who has experienced the anxiety which comes of uncertainty in regard to the character of the material of a structure, in which a single defective piece may cause the destruction of the whole with enormous loss of time, money, and probably of life, will understand what good comes of a system of inspection and test that entirely relieves both conscience and pocket of responsibility and risk.

A method of inspection which, as I showed ten years ago, will safely determine the value of each piece subsequently to be actually put into the structure or machine, is now slowly becoming adopted, and we may hope that soon we may confidently assert of each bridge over which we ride, of each machine upon the strength of which depends safety of life and property, that its every part has been proven, by actual test before use, to be perfectly safe. Now that the great testing machine at Watertown Arsenal, set up by the unfortunately defunct board appointed in 1875 to test iron, steel, and other metals, is at the service of the public, we may hope that such methods of test may hereafter become common, and that tests of full-sized parts of bridges and machines, made at private cost, may, to a limited extent at least, yield the knowledge that that Board would have more systematically and at less expense have made familiar to engineers, had its life not been terminated at the very beginning of its labors.

PRODUCTION OF IRON AND STEEL.

I have to thank General Walker, the superintendent of the Census, for many valuable data, and not the least interesting of all is the report of Mr. Swank, on the iron trades, of which I am supplied with an advance copy. I know of no better gauge of the extent and importance of the work of the mechanical engineer than the production of iron and steel. These metals are worked up by the mechanical engineer and the trades associated with the profession, and the consumption of the raw material is the truest measure of the magnitude and value of our work.

The growth of the iron manufactures of the United States has all occurred since A. D. 1700, when there was not a blast furnace in this country, and principally since the year 1794, when the first steam engine was erected in America, eighteen years after James Watt made the improvements that have given him fame, and that have given the world more wealth and comfort than had been accumulated during the many centuries of civilization historically known to us as preceding his time.

To-day, we have over 1,000 iron and steel works in the United States, employing $230,000,000 in capital, as against $122,000,000 in 1870–1871, producing 7¼ millions of tons of iron and steel, just double the production of 1870, and employing nearly 150,000 men. The value of all products is not far from $300,000,000, and wages amount annually to about $55,000,000. In ten years Massachusetts has increased her product 65 per cent.; West Virginia, 104 per cent.; Alabama, 800 per cent., nearly; Georgia, 125; and Tennessee, 125 per cent.

Pennsylvania holds her place at the head of the list, producing 3¼ millions of tons per annum; Ohio makes one million; New York, 600,000; Illinois, 400,000; New Jersey, a quarter of a million; and other States smaller amounts.

Since the year 1870, we have increased the weight of pig metal from 2 to 3¾ millions of tons per annum, or 84 per cent.; rolling mills make 2¼ millions of tons of rolled iron, an increase of two-thirds; the Bessemer steel manufacture has grown from less than 20,000 tons in 1870 to 900,000 tons in 1881. "Open hearth steel" is now reported at about 95,000 tons, and this is an industry which was unknown in this country in 1870. Of crucible steel, we make 70,000 tons—a gain of 150 per cent. in the decade—and its applications are extending wonderfully, day by day.

But Great Britain still remains at the head of iron-making countries, turning out 8 millions of tons of pig iron during the year, an increase of one-third since 1870, and the increase still continues. The weight of Bessemer rails made has reached above 700,000 tons, and of Siemens-Martin steel a quarter of a million tons per annum. Germany and France exhibit similar gains in amount of iron and steel made, and other countries of the world follow after.

Even Italy, famous as the home of the fine arts, yet disgraced by her neglect of the useful arts—the country of beautiful art galleries and of uncomfortable homes—has produced about 300,000 tons of iron ore, of which a small amount is there worked into finished iron. The artistic sense of her people is even here seen, and her blacksmiths make architectural work in hammered iron which would have satisfied even Michael Angelo.

IMPROVED PROCESSES.

The introduction into open hearth steel making of the Pernot furnace with its revolving saucer-shaped hearth, and of the Ponsard furnace with its modernization of the ancient process, are the latest steps in the improvement of steel-making apparatus; and the dephosphorizing process of Thomas and Gilchrist, by permitting the use of hitherto condemned ores, will prove a grand step in the reduction of cost of Bessemer steel, which must hasten greatly that inevitable change which will, ere long, replace malleable iron by steel in all of its myriad uses. Good mild steel can at last be made cheaper than good iron, and we are now entering fairly into the "steel age."

This is the grandest of all the industrial revolutions that have affected the iron trades; although its influence upon the prosperity of the nation and of all civilized countries cannot be yet estimated, we may be sure that it will be hardly less observable, and that it will be of hardly inferior importance to the world, than was the introduction of puddled iron a century ago.

We are using steel in every department of our work, and that most remarkable of all its many grades, Whitworth's compressed metal, is now at last coming into commercial importance; and of it are to-day made shafts for the largest steamships and ordnance that has no equal in strength and endurance.

Any size desired can now be made in cast steel, and 100-ton ingots, shaped under 80-ton hammers, are the *pieces de resistance* of at least one European establishment.

CHANGES IN TEXTILE MANUFACTURES.

The progress of art, directed by brain and sustained by energy, skill, and enterprise, is well illustrated by the changes which have taken place in our textile manufactures. According to Atkinson, a century ago one person in each family was compelled to work, day in and day out, nearly the whole year, to furnish home-spun and dress goods for the rest; to-day, such has been the progress in the introduction of mechanism and automata, that one day's work in the year will, on the average, be sufficient to enable each worker to supply himself with all needed cotton and woolen fabrics.

Speeds of cotton spindles have risen, during the two decades that my memory can follow the change, from 5,000 to 7,500 revolutions per minute. Looms then making 120 picks per minute make now, Mr. Webber tells me, as high as 160, and one hand takes charge of from 25 to 50 per cent. more work. The "Slasher" dresser does *ten times* the work of the old machine, supplying 400 looms in place of 40, and demanding the attendance of only one man and a boy, instead of two men and ten girls. Pickers handle a ton of cotton per day in place of a half or five-eighths ton.

The cheaply made turbine driving these mills has completely displaced the old costly vertical wheel, doing the work with less water and greater steadiness.

Its efficiency has risen from 70 or 75 to 80 and 85, and sometimes to 90 per cent.

When the last generation was in its prime our factories were in operation twelve or thirteen hours. "Man's work was from sun to sun, and woman's work was never done." To-day man works ten hours, and woman is coming to a stage in which she will work where, when, and how she pleases. Then three yards an hour was the product for a single operative; to-day ten yards per worker are produced. In twenty years the annual product in cotton mills has risen from 2½ tons to 3½ tons per annum per mill-hand; wages have increased 30 per cent., and the buying power of the dollar has risen in much more than equal proportion, thus adding 50 per cent. to the comforts and luxuries of working people, permitting an increased number of happy marriages and comfortable homes, setting free the child-slaves of the mills, and turning them into the schools.

Where one hand then drove forty spindles, he now manages sixty; and every seven of the more than ten millions of spindles in operation work up a bale of cotton each year and turns out a hundred dollars worth of product. This product is supplied to the most indigent of our poor at a small advance on the one and a half cents for labor, and equal sum for raw cotton, which are expended in the manufacture of the cheapest grades. A still more striking fact is the distribution of our cotton goods to distant countries. A single mill operative at Fall River, Lowell, or Providence makes each year cotton cloth enough to suppy 1,500 of the people, who pay her wages by sending her tea.

In regard to woolen manufactures we have the same story to tell. All machinery has been speeded up, product increased, labor diminished, costs lessened, and machinery given greater automatism and higher efficiency both in making ordinary goods and in adaptation to finer grades. The manufacture has had a healthy growth, and the product is daily competing more successfully with the best of imported goods.

THE SILK INDUSTRY.

It is, I find, difficult, perhaps impossible, to make an exact statement of the extent of recent progress in the silk manufacture in this country.

Power looms and automatic machinery have been introduced more slowly in this trade than in others. Yet progress has been made. New and improved apparatus is steadily displacing older forms; power machinery is taking the place of hand-worked machines—with some rapidity in mills working the coarser grades, and more slowly where the finest goods are produced.

The strength, durability, and finish of all kinds of silks are constantly becoming more and more nearly equal to the best imported. Indeed, the ladies assure me that some makes of American silk wear much better than any of foreign make yet seen in our market, and that several grades have a finish which compares favorably with the very best of European silks. In variety and in quantity of goods produced a steady gain is to be noted. The ingenuity of the American workman, aided by talent and experience coming from the older silk-making provinces of Europe, seem likely to give to this manufacture a position of which its promoters may well be proud.

Mr. Wyckoff, Secretary of the Association, reports, June 30 of the current year, a production in the United States of nearly $35,000,000 in finished goods, by about 400 factories, employing a capital of $19,000,000 and over 30,000 operatives, whose wages amount to about $9,000,000 per annum. Good progress this for an industry often condemned as exotic, and one which has only become established within the remembrance of the majority of our members! A half million spindles, running often 10,000 revolutions per minute instead of 5,000 as a few years ago, and over 5,000 power and 4,000 hand looms, make a large showing. Spinning frames occupy one four-hundredth the space, and cost one-twentieth as much per spindle as in the earlier days of the trade, and the cost of work has now become so small that $3.00 per pound spent in wages make silk costing $5.00 per pound into finished goods averaging $11.50.

MACHINE TOOLS.

In machine work generally the distinctively American idea of manufacturing as opposed to the old methods of making parts of mechanism in large numbers is steadily progressing, thanks to the ingenuity of mechanics like our colleagues, Pratt and Whitney and others, in devising tools specially designed for the production of definitely limited kinds of work.

The same wonderful genius of invention which produced the Whitney cotton gin, the Blanchard lathe, our screw machinery, and the more wonderful cardsetting machine, has lately given us Sellers' automatic gear-cutter, the automatic turret-lathe, and a thousand and one machine tools hardly less remarkable in construction and efficiency.

RAILWAY PROGRESS.

Turning to the examination of the present condition of the railroad system of our country—that system which, binding State to State with lines of steel, is our strongest safeguard against political dissension and disunion—we find that changes are everywhere in progress under the direction of some of the ablest members of our profession.

It is now seventy years since Col. John Stevens, in his memorable correspondence with Dewitt Clinton, urged the adoption of a complete system of steam transportation on railways, and asserted that the time would come when "suits of carriages," as he said, would make their journeys, impelled by steam, with as much celerity in the darkest night as in the light of day, and stated that he "could see nothing to hinder a steam-carriage moving on its ways with a velocity of 100 miles an hour," and that he "should not be surprised" at seeing them propelled 40 or 50 miles an hour. His contemporary, Oliver Evans, wrote: "A carriage will start from Washington in the morning. The passengers will breakfast at Baltimore, dine in Philadelphia, and sleep in New York the same day."

But it was a generation later before these prophecies were credited; it was only when, fifty years ago, the introduction of railroads had an actual beginning.

To-day we have a hundred thousand miles of track laid down in the United States—we have about one-half of the constructed railroads of the world. Trains here and in Great Britain make 50 miles an hour on schedule time, taking water from the track, and receiving and delivering mails without stop. A speed of 100 miles—Stevens' maximum figure—has been many times attained. Locomotives are frequently built weighing 50 tons; 70 tons has been reached, and every builder of engines is ready to guarantee the performance of an engine to draw 2,000 tons 20 miles an hour on a level track. In coal consumption we have made some saving of late years. Three pounds of coal per hour and per horse-power is a usual power, and a consumption of 2·6 pounds (1·3 kgs.) of coal, and of 22½ pounds (10 kgs.) steam has been reported from recent locomotive tests.

The trapping of cinder and the reduction of intensity of combustion by extending grate area are late improvements. The time will come, and it should have come already, when the nuisance of flying dust and cinder will be unknown.

Comparative comfort has at last come to the weary traveler in our parlor and sleeping cars, and the greatest of all modern improvements in this department, the Westinghouse continuous brake and the Miller platform and coupler, have decreased the risks of journeying by rail to a merely infinitesimal quantity. A train which, when at full speed, can be stopped within its own length, is comparatively safe against the most serious of usual contingencies.

Steel rails have driven out iron, and this superior metal is slowly and surely taking the place of its defective rival in boiler and running parts. It is an interesting fact that, while Bessemer steel is used for rails, open-hearth steel is coming to be as exclusively used for all parts of the locomotive.

STATIONARY ENGINES.

The efficiency of the late styles of stationary engines is illustrated by figures like these: Corliss obtains a duty, as reckoned from figures recorded by my assistant at a recent 12-hour trial of his last Providence pumping engine, of 113,878,580, without reduction or allowances, and the average of several days' trial is 112 millions. Leavitt gives me data showing a duty for months together of about 105 millions, and obtains a horse-power with an expenditure of 16½ pounds of feed-water per hour at Lynn and 16·23 at Lawrence. His Calumet engine with wet steam and but 200 feet piston speed, demands but 18 pounds (8·2 kilos), and the Hecla hoisting engine is credited with the wonderfully low figure 16 pounds (7·3 kilos). This, by the way, is the more remarkable from the fact that the jackets were disconnected. We thus sometimes meet with hints, apparently, that we may do better work with an underheated than with an overheated cylinder jacket. The performance of the West-side pumping engines at Chicago, giving a duty of nearly 100 millions with lower heads only jacketed, is similarly significant.

This figure—16 pounds of steam per hour and per horse-power—may be put on record as the very best economy attained by our best engineers at the end of the decade 1870-1880. It is just double the weight which would be required in a perfect engine working steam of the same pressure at maximum efficiency. This leaves us still a fair margin for further advance in the construction of the engine. The steam boiler is at a standstill; there is but little margin for gain in economy, but a large gain in weight of steam supplied per pound of boiler may be expected when the tardily recognized advantage of forced circulation is secured.

Air and gas engines are here competing with stationary steam engines, and, so far as I can see, in no other field. The compressed air engine, the petroleum engine, and the gas engine are all just now coming forward. I have no figures that I can rely upon except for the gas engine, which sometimes consumes as little as 18 cubic feet of gas (half cubic meter nearly) per hour per horse-power.

The solar motor proposed by Ericsson, the inevitably coming motor of some far-distant epoch, has as yet made no progress beyond the plans and experiments of the inventor.

I have nothing to report relative to either the development or the application of the theory of heat engines. The splendid labors of Rankine and the work of that most logical and classical, if less practical writer, Clausius, have so cleared the field that later investigators are driven into the exploration of minor departments of thermo-dynamics. The engineer is to-day seeking, with the aid of the physicist, to determine the facts and the laws governing the exchange of heat between the working fluid and its inclosing walls. This is for him to-day the greatest of the problems presented in this department.

ECONOMY IN FUEL.

The purely commercial aspects of steam-engine economy, familiar as they have long been to builders of expensive engines and to the more intelligent buyers, have barely attracted the attention of engineers generally, and have as yet apparently been entirely overlooked by all having a scientific standing with, I think, the solitary exception of that greatest of modern scientific engineers, Rankine. A year ago, in debate, I called attention to the fact that economy in fuel was but one among the many items of expense incurred in the operation of steam machinery, and that it formed by no means the greatest part of such expense in certain cases. The inference at once follows that commercial economy, affected as it is by all these items, must be studied with reference not to cost of fuel simply, but with a view to making total expense a minimum. Rankine called attention to this obvious conclusion many years ago, and a paper presented by two of our colleagues at the May meeting in Hartford, extending Rankine's work, and applying his approximately exact method to modern engines, showed that commercial efficiency is often made a maximum with very much smaller engines, and lower rates of expansion, than are found to give maximum economy of fuel. Such methods of determining size of engine will probably be generally adopted by engineers seeking the best interests of their clients. We are not, it is evident, to conclude, from the results of the application of the Rankine method of determining size of engine and maximum commercial efficiency, that we are always to lose so large a proportion of the gain obtainable by further expansion of steam. We conclude, rather, that the engineer must direct his attention to improvements designed to reduce these counteracting wastes. He must find methods of rendering the machine, including boiler, automatic, and thus of reducing cost of attendance; he must find ways of reducing first cost, as by increasing speed and making smaller engines do the work, as by finding ways of building cheaply, yet doing good work, and of making lubrication less costly, or of doing away with it altogether. Automatic firing, or "stoking," automatic feeds, and automatic cleaning apparatus are already in use, as well as automatic regulation of the engine, of steam pressure, of point of cut-off, and of chimney draught. All these improvements, when once made successful and thoroughly reliable, will come in effectively to aid the engineer in this direction, as well as the more direct advances in progress in the direction of reducing back pressure and of checking cylinder condensation, of increasing steam pressure, superheating, and obtaining by the use of all known methods high ratios of expansion at maximum efficiency. The engineer and the physicist working hand in hand in the future as they have in the past—or perhaps the engineer-physicist—will sooner or later, following the paths pointed out by Smeaton and Perkins, and in our time by Corliss, Porter, and Leavitt, greatly reduce the now often broad margin between theoretical efficiency and commercial economy. When the engineer has once acquired the habit of gauging the value of an engine by the magnitude of its ratio of expansion at maximum efficiency, all this latter class of improvements will advance with increased rapidity, and when he sees that the magnitude of the ratio of expansion at maximum commercial economy is a gauge of his success in making steam power useful, the first class of improvements and of inventions will similarly advance, while we shall gladly approximate to mechanical perfection, and this progress will occur at a rate which will be measured by the approach of the two ratios of expansion to the same maximum, finally both becoming nearly coincident with the ratio of maximum efficiency of fluid for each given case.

The "compound" engine has become the standard type of steam engine in use on shipboard as well as for stationary pumping engines. We still hear occasionally intimations that a counter-revolution and return to the single cylinder type of engine may be expected, but that change is not observable.

PROGRESS IN MARINE ARCHITECTURE.

The direction and extent of recent advances in marine architecture are readily noted. The proportions of length of ship to breadth remain, as during several years past, about 10 to 1 or 11 to 1, about 50 per cent. greater than has been considered by some of the best engineers as that giving highest efficiency. The Great Eastern, 680 feet long, of 83 feet beam, and measuring 25,000 tons displacement, still remains the largest ship yet built; but steamers are under construction for transatlantic lines 600 feet long, of over 50 feet beam, and fitted with engines of 10,000 indicated horse-power. A speed of twenty miles an hour in good weather throughout the voyage, making the distance from land to land in less than a week, may be expected soon to become usual. Double hulls and transverse bulkheads will make these great vessels safe even against the shock of collision with an iceberg.

IMPROVED MARINE-ENGINES.

Steam pressure has gradually and steadily risen since the time of Watt, when 7 pounds—half atmosphere—was usual. To-day 6 atmospheres (75 pounds per square inch) is as usual, and 7 atmospheres (90 pounds) is often adopted. Such pressures have compelled the general introduction of the simplest form of steam boiler; the cylindrical tubular boiler, with large flues beneath the tubes, in which the furnaces are formed. Strength of flues is obtained by the use of heavy plates, sometimes flanged at the girth seams. "Mild" steel is here slowly displacing iron.

I have had occasion to remark that in ordinary practice increase of steam pressure with correspondingly increased expansion gives, roughly stated, a decreased steam consumption, about in the ratio of the square root of the pressure. This seems true in recent marine engineering; during the past ten years steam pressure has risen from 4½ to 6 atmospheres—50 to 75 pounds by gauge—and the consumption of fuel per hour and per horse-power has decreased from 2 to 1·8 pounds (0·9 to 0·8 kilogramme). Incidentally the area of heating surface has decreased from 4½ to 4 square feet (0·4 to 0·37 square meter) per indicated horse-power, that is to say, remaining, as formerly, nearly 2 square feet per pound of coal burned per horse-power per hour (0·4 square inch per kilog.); where, as in some cases, pressures of 100 and 125 pounds are adopted (7 to 10 atmospheres, nearly), somewhat further gain may be expected.

Increased pressure has been accompanied by increased speed of piston—from 300 to 500 feet per minute (100 to 150 meters nearly)—and both causes have combined to reduce greatly the size and weight of engines. Formerly 500 pounds (220 kilogs. nearly) per indicated horse-power was a common figure; to-day one half that weight is often noted, and in special cases in which, as in torpedo boats, economy is not important, one-fifth, and even one eighth those weights are said to have been reached.

Surface condensation is almost exclusively adopted, but the area of cooling surface is becoming less and less, and at the pressure soon likely to become general, the production of a vacuum may possibly cease to be desirable, as it is already known to be with unjacketed cylinders, and the non-condensing engine may yet displace the condensing engine at sea as it has on land, and on our Western rivers, where this comparison was earlier made and where the evil effects of cylinder condensation were earlier perceived. A still for condensing exhaust and waste steam into feed water has already been used, and it must remain in use in all salt-water navigation.

THE ANTHRACITE AND THE LEILA.

Among the most interesting events of the years 1880-1881 have been the trials of the steam yachts Anthracite and Leila. The first is a small vessel, 86 feet long, 16 feet beam, and 9 feet draught (27 × 5 × 2¾ meters nearly), fitted with a three-cylinder compound engine, and carrying 300 pounds steam (20 atmospheres nearly) and upward.

Trials in London show these engines to have required but 1·7 pounds of coal (0·8 kilog.) and 17·8 pounds (8 kilogs.) of steam per hour and per horse-power. Cylinder condensation amounted to 30 per cent. in the first cylinder, and of this nearly three fourths was re-evaporated before discharge from the third cylinder.

The same engines tested in this country require 21·6 pounds (10 kilogs. nearly) of steam per hour and per horse-power, the cylinder condensation becoming over 50 per cent., of which four-fifths was re-evaporated before reaching the condenser, the difference being probably due to a variation in the efficiency of the steam jackets and in speed of engines. This little yacht—the smallest that ever crossed the Atlantic—should be remembered in history, quite as much on account of the lessons in engineering learned on board the little craft, as on account of her far-famous voyage.

The trial of the Leila, under the orders of the U. S. Navy Department, was even more instructive than that of the Anthracite. The Leila is a Herreshoff yacht, 100 feet long, 13 feet beam (30×3¼ in. nearly), and measuring 87 tons. With a "coil" boiler, steam at 120 pounds at the steam chest (9 atmospheres), and driving the boat 15 knots an hour (17 miles), the engines developed 150 horse-power, using but 16.4 pounds of steam (7·5 kilogs.) per hour per horse-power. The cylinder condensation amounted to but 10 per cent.

An important deduction from the results of the trial of the Anthracite and the Leila is, that efficiency has little relation to size of engine when protection against cylinder condensation is secured, and this conclusion is further justified by the fact that some of the very best work has been done, where non-condensing engines have been compared, by small portable engines. Steam engines of five thousand horse-power are equaled in economy by engines of one-fiftieth that power. A large difference in magnitude seems more than compensated by a moderate difference in steam pressure. We may conclude that high steam pressure cannot be expected to give great economy unless employed intelligently. The highest pressure may prove least economical when the engineer neglects to provide against loss by cylinder condensation. In the cases of the Anthracite and Leila, the higher pressure gave least efficiency. We may, perhaps, obtain some idea of the relative efficiencies that should have been attained in the following manner.

Assuming that the steam condensed and re evaporated had one-fourth the value of that remaining, the work done per unit of weight of working steam becomes for the two cases nearly as $\frac{70+7\frac{1}{2}}{70}=1{\cdot}11$ is to $\frac{90+2\frac{1}{2}}{90}=1{\cdot}03$, and as 16 pounds of steam per hour and per horse-power is to 15·9—practically the same, although the steam pressure was twice as great in the first case as in the second. We are evidently finding it more and more necessary to discover some means of making the interior surfaces of our steam cylinders of non-conducting material. That accomplished, the cost of power, in quantity of steam used, will be reduced from ten to fifty and more per cent., according to the kind of engine considered. Until that is done, superheating, steam-jacketing, and high speeds of piston must be relied upon to give high efficiency; but only perfectly adiabatic expansion can give maximum economy of steam.

The error, long since detected by engineers experienced in the management and familiar with the working of steam engines, which has been fallen into by writers of authority, who have assumed that the condensation of steam due to transmutation of heat into work, discovered by Rankine and Clausius, produces the principal part of the water observed in the cylinders of engines working dry steam, is becoming generally recognized, and later writers are in a fair way to learn that it is not the fact that "the greater part of the liquid water which collects in unjacketed cylinders" "is produced by liquefaction of steam during its expansion;" but that this latter amount is insignificant, and that this water comes of cylinder condensation, sometimes with considerable leakage, and often amounts to a half or more of all the fluid supplied by the boiler. This fact once well understood, it may be hoped that this defect, existing in all heat engines, may soon be remedied to such an extent as no longer to constitute the great obstacle to further advance. The working of a fluid, of which the efficiency depends upon adiabatic change of volume, within a vessel so perfectly pervious to heat as is an iron steam cylinder, from the physicist's stand point, involves an absurdity.

The trials of steam engines, now often conducted by the Forey & Donkin method of measuring the heat rejected, afford a reliable means of measuring actual efficiencies. Recently, Eckart has applied the chronoscope of Hipp to the determination of the exact velocities of piston in mid-stroke, and we may expect soon to know much more than we do at present of the precise action of steam in the engine, and of causes of variation in efficiency.

PROGRESS IN NAVAL ENGINEERING.

Naval engineering is one of the most interesting and important branches of our profession, and the progress which has been made in its field during our generation illustrates the advances observed in nearly every other department. Naval works, whether in the civil or the military—in the "merchant" or the distinctively so-called "naval"—marine, is to-day become almost purely the work of the mechanical engineer. The shipbuilder constructs his ships of iron and steel; their lines are laid down by the laws of engineering science; their parts are formed in the machine shop and put together by the same methods that are adopted in constructing their boilers. They are driven by steam engines designed and built by our fellow engineers, and the winds no longer either aid to any great degree, or seriously impede, their progress. Even their loading and the discharge of their cargo have become minor matters of engineering. The old-fashioned mariner is rapidly disappearing, and the engineer is likely to become the responsible officer on the voyage as during construction.

Progress, if not more rapid in the navy than in the army, is more observable, and to me, at least, and perhaps partly because of my personal knowledge and closer relations, more interesting in its connection with engineering. A generation ago, the French Napolean line of battle ship, with her 100 guns and 600 horse-power engines, represented the most formidable of naval vessels. A little later—18·6—our Wabash class of screw frigates, with their fewer, but much heavier, guns, were thought the type of the coming fleet; but it was then that the modern ironclad came to revolutionize all naval warfare.

Those greatest of engineers, Robert L. Stevens and John Ericsson, and the greatest of naval architects, Edwin J. Reed, have led the way to the construction of the war ship of to-day—a craft carrying ordnance weighing from 25 to 160 tons, at speeds varying from 12 to 16 knots; plated with from 14 to 30 inches of armor, and yet penetrable by their own guns—a great fighting machine, designed, constructed, and mainly operated by engineers. The daily advance noticeable in naval construction is a progress leading directly and rapidly toward bringing all naval warfare within the province of mechanical engineering. The fighting sailor of earlier days is giving place to the fighting engineer and mechanic, upon whom success in handling these great fighting machines must inevitably depend. To-day, if two professions are to be combined, it is easier for the engineer to learn and to practice the duties of the sailor than for the seaman to make himself at home among the cranks and shafts, the rods and the valves of the engineer. In our own navy, the line officer is becoming a skilled engine-driver, and the engineer is studying in all the higher departments of his profession, both in naval and steam engineering.

But a revolution is impending that will produce as yet unknown changes.

Ten years ago I proposed a classification of naval vessels, which was a little later again proposed by J. Scott Russell in a modified form. I stated that the increase so rapidly taking place in weight of ordnance and armor must sooner or later compel the division of all navies into three classes of ships, and an independent service of torpedo vessels: (1) a class of vessels for service in time of peace, of moderate size and speed, carrying a few heavy guns, unarmored and with great sail power; (2) a class of unarmored ships of very high speed under steam and carrying a light battery, such ships as might be best calculated to destroy the commerce of an enemy; and (3) a class for heavy fighting, carrying the heaviest of guns and the most impenetrable of armor, with as high steam power as possible, and rendered, by division

into compartments, as nearly unsinkable as possible. A few years later, I stated that "the introduction of the stationary, the floating, and the automatic class of torpedoes and of torpedo vessels has now become accomplished, and this element, which it was predicted by Bushnell and by Fulton, three-quarters of a century ago, would at some future time become important in warfare, is now well recognized by all nations. How far it may modify future naval establishments cannot yet be confidently stated, but it seems sufficiently evident that the attack, by any navy, of stationary defenses, is now quite a thing of the past. It may be looked upon as exceedingly probable that torpedo ships of very high speed will yet drive all heavily-armored vessels from the ocean, and complete the parallel between the man-in-armor of the middle ages and the armored man-of-war of our times." These words are fully justified to-day; and the non-success of naval vessels in later wars, and the production of such craft as the Polyphemus, making 17 knots, and as Ericsson's Destroyer, with its great submarine gun, and the self-propelling torpedo, guided from the shore, are simply very large straws, showing that the coming days of freedom on the high seas and of cessation of all naval warfare are not far away. This most splendid of revolutions is to be the work purely of the mechanical engineer. I have no doubt that many among my audience will live to see that forerunner of the millennium.

IMPROVEMENTS IN ORDNANCE.

Gunnery is a branch of our profession which has been too much neglected by engineers; and progress, dependent upon laymen and upon a few of the military class, whose tastes rarely lead in the direction of construction, although, perhaps, much more rapid than should have been expected, is much slower than may be anticipated, when this special department becomes the chosen field of educated, well-trained, and talented mechanical engineers.

From the days of Tartaglia and of Rumford, the direction of movement has been readily traceable. Stronger and safer ordnance metal, breech-loading in place of muzzle-loading, increased velocity of projectile, a flatter trajectory with less lateral drift and with enormously increased range, are the features of changes now occurring. Whitworth's compressed steel, Krupp's breech mechanism and skillful design and construction have given us guns capable of driving shot at velocities or over 1,200 feet (over 366 meters) per second with small arms, and nearly 2,000 feet (600 meters) with heavy ordnance. Whitworth, with a comparatively small piece, has attained a range of nearly ten miles. The "machine guns" of Gardner, as built by Pratt and Whitney, and the Gatling and others, as constructed by the Colt Co. and the Ames Manufacturing Co., firing a thousand shots a minute, have rendered the old methods of warfare, in which large masses of troops were deployed in the open, entirely obsolete, while the accuracy of sharp-shooting at ranges of 1,000 yards or more makes the use of any unprotected ordnance at short ranges extremely difficult.

Hollow cast guns, as made by Rodman, although the best cast-iron ordnance ever known, are now of the past; and even the Armstrong, the Woolwich, and other guns built up in the forge, fail when made of 80 and 100 tons weight, as now demanded, and must inevitably, as I predicted several years ago, give place to solid steel guns of the Whitworth or other stronger type. Improved methods of making explosives and better adjustment to the work by variation of composition, and especially size and density of grain, have enabled us to keep pressures much below 25 tons per square inch, while greatly increasing the energy developed per pound burned and correspondingly increasing the effectiveness of ordnance.

The theoretical energy of good powder is about 250,000 or 300,000 foot pounds (80,000 to 90,000 kg. m. per kg. nearly) per pound. In experiments, every day in progress, we now get an actual result equal to two-thirds.

This is a branch of thermodynamics that must soon attract the attention of some scholarly engineer familiar with practical work, and we may hope that so fruitful a field will not much longer be left so entirely uncultivated. There is, to-day, however, no difficulty in designing a gun to do any specified work, and but little in determining the resistance to be met and the energy demanded at a given range, or when attacking armor plate. Fortunately, however, the days of ironclads and of naval warfare will soon be numbered. Guns can be made to penetrate any thickness of armor that can be floated, and when the importance of a long bore, with slow burning or intermittently burned charges, becomes recognized, the effectiveness of ordnance against any armor will be such that the ironclad will soon vanish from the seas. There is still much to be done in perfecting ordnance, however, especially in its construction, and as yet our ordnance officers are completely at sea in respect to systems of construction of large guns. Treadwell and Woodbridge have pointed out one direction of progress by the application of the strongest known form of metal—hard drawn steel wire—in building up the barrel, and Whitworth has shown what wonders can be accomplished with steel in masses. Some of our fellow engineers will undoubtedly go still further in this direction. The gun is already a heat engine of high efficiency, but thermodynamic investigations will show that this gas engine may be made still more efficient, and the chemist and engineer will aid each other in perfecting it. A gun in which the charge expands 25 times should give to the shot an energy of 300,000 foot pounds per pound (90,000 kg. m. nearly) of good ordinary powder, and such a standard must sooner or later be closely approximated. As the heat is generated and expanded in a very small fraction of a second, the gas expands adiabatically, or isentropically, as Gibbs and Clausius would say, and the loss should be small except by incomplete expansion. It is sufficiently evident that we are yet to see the air chamber used intelligently and, therefore, our guns lengthened greatly, and carefully proportioned to their work. It does not even yet appear to have become understood that recoil is often simply an evil, and an avoidable one, with breech-loading guns; but the time must come, I think, when ordnance whenever possible, if maximum battering power or range is required, will be held fast against recoil, and thus the defect in efficiency, all the inconveniences, and some of the dangers now due to this waste of energy will be avoided. Recoil is, with modern ordnance, often an unmitigated and inexcusable evil. Increased accuracy and power with flattened trajectory and reduced drift will come with these improvements, and the last will give much greater convenience and safety in working, and will aid still more in the effort, which the engineer naturally makes, to unite guns and supporting structure as closely and firmly as possible.

THE FUTURE OF ELECTRICITY.

That feature of recent progress in engineering which is to-day attracting most attention and awakening most interest in the minds of the public as well as of the profession, is the introduction of machine-made electricity, and of the electric light; but what seems to me the most important phase of this impending revolution is, I think, not yet generally comprehended. By the ingenuity and skill, the courage and persistence, the energy and enterprise of our brother engineers, Brush and Edison and their coadjutors, it seems certain that the dream of the great author of "The Coming Race" will in part be speedily realized, and that for the occasional mild light of the moon, or the yellow sickly flare of the gas flame, will soon be substituted the less uncertain and always available, and equally beautiful and mellow radiance of the electric flame. This is but a beginning, however. A few months ago one of the earliest and best workers of all who have been with me—at once friends and pupils—made a very painstaking investigation of the efficiency of a powerful dynamo-electric machine, kindly loaned him from Menlo Park. The mean of several series of tests gave, as a result, an efficiency of between 90 and 95 per cent. That is to say: Of all the power transmitted to the machine from the steam engine driving it, over 90 per cent. appeared on the wire in the form of electrical energy. It follows at once that mechanical power may be transmitted through two such machines, again appearing as mechanical power, with a loss of less than 20 per cent. And it follows from this last fact that the distribution of power by electricity is not unlikely to prove a more important application of this wonderful force than is the electric light.

It is to this inestimably important advance in that field in which the mechanical engineer and the electrician have joined hands that we owe the probable early success of the electrical railway, that promising scheme of simplifying the problem of transportation on our elevated railways; and it is not unlikely that the rising generation may see the completely successful introduction of this method of distributing power from a central source in our great cities, and even from that mighty reservoir, Niagara, with its 3,000,000 horse-power, to far distant cities on either side of this great continent. Sir William Thomson has stated it as probable that 25,000 horse-power may be sent by this method from Niagara to New York, Philadelphia, or Boston through a half-inch copper wire, losing twenty per cent. in transmission; he would effect distribution by using the Faure battery as an accumulator. The competition of this method of distributing light, heat, and power with the already practical plan of steam distribution introduced by Holly, of Lockport, and now coming into use in New York city under the direction of Emery, will be watched with unusual interest.

THREE UNWORKED FIELDS FOR INVENTION.

I have sometimes said that the world is waiting for the appearance of three great inventors, yet unknown, for whom it has in store honors and emoluments far exceeding all ever yet accorded to any one of their predecessors.

The first is the man who is to show how, by the consumption of coal, we may directly produce electricity, and thus, perhaps, evade that now inevitable and enormous loss that comes of the utilization of energy in all heat engines driven by substances of variable volume. Our electrical engineers have this great step still to take, and are apparently not likely soon to gain the prize that will yet reward some genius yet to be born.

The second of these greatest of inventors is he who will teach us the source of the beautiful soft-beaming light of the firefly and the glow-worm, and will show us how to produce this singular illuminant, and to apply it with success practically and commercially. This wonderful light, free from heat and from consequent loss of energy, is nature's substitute for the crude and extravagantly wasteful lights of which we have, through so many years, been foolishly boasting. The dynamo-electrical engineer has nearly solved this problem. Let us hope that it may be soon fully solved, and by one of those among our own colleagues who are now so earnestly working in this field, and that we may all live to see him steal the glow-worm's light, and to see the approaching days of Vril predicted so long ago by Lord Lytton.

THE PROMISE OF AERIAL NAVIGATION.

The third great genius is the man who is to fulfill Darwin's prophecy, closing the stanza:

> "Soon shall thy arm unconquered steam, afar
> Drag the slow barge or drive the rapid car,
> Or on wide-waving wings expanded bear
> The flying chariot through the fields of air."

The quotation may excite a smile to-day, but when first published, just one hundred years ago, the last lines must have seemed hardly more extravagant than the first.

And it is to-day true that we are getting on, that even in the science of aeronautics progress, although slow, is still to be observed year by year, and there is no department of engineering in which the art of the mechanic has opportunity for greater achievement. We have not yet learned to fly like Dædalus, and thus have escaped the fate of Icarus, but the flying automata of Archytas and of Regiomontanus have been matched in our own times, and the navigation of the air is, very possibly, on the point of real advancement.

When it is considered that it is only 98 years, last June, since the Brothers Montgolfier invented the balloon inflated with hot air, and that two months later M. Charles made use of hydrogen for inflation, it will, I am sure, be admitted that the progress which I am about briefly to sketch is far from being discreditable. Since Charles Green, the famous English aeronaut, just sixty years ago, substituted coal gas for hydrogen, the progress of ballooning has been rapid, and science is greatly indebted to Biot and Gay Lussac, to Flammarion, to De Fouville, and especially to Glaisher, among balloonists, although, as yet little direct advantage has come to mankind from their efforts. The practical application of the balloon has been confined almost exclusively to the purposes of military reconnoissance. During the Franco-German war the great French naval engineer, M. Dupuy de Lôme, succeeded in giving to the balloon a slow motion by means of a screw, and in directing its course by a rudder. His balloon was spindle or cigar-shaped, and contained 12,000 cubic feet of gas. It could carry fourteen men, and the screw was worked by four or eight men. But while it could be moved slowly in calm weather, this machine gave no encouragement to hope that self-impelling balloons will ever become successful. To support the weight of machinery they must have great bulk, and with great bulk no machinery yet devised is light enough, yet strong enough, to drive them at any such speed as is necessary for navigation in even a moderate breeze. Our only hope lies in the direction of flying machines lifted by their own power, not buoyed up by gas.

And this scheme cannot hastily be condemned, nor by any means at once decried as chimerical, although, to-day, there is but little accomplished by man in this direction. The carrier pigeon and the wild goose are but animated flying-machines, and it can hardly be pronounced impossible that man shall yet compete with them in their own element, as he has long since learned to excel the fishes in their element. And a little has actually been done. Men of science like Pettigrew, Marey, and De Lucy have studied the insects, have learned the laws of fluid resistance, and have paved the way to a real advance. The theory of propulsion has been long studied, and in some directions well established. It has been shown that weight is probably not objectionable in aerial navigation, but actually a necessity; not weight but volume constitutes the impediment. A bird is a heavy but compact structure, of which the essential characteristic is that it incloses great power within small volume. De Lucy's measurements of various flying creatures show an irregular but still unmistakable general direction of variation of wing surface with size of animal. Comparing the lady-bird and the stag-beetle, the pigeon and the stork, the sparrow and the crane, we find the area of wing per unit of weight carried to be nearly as the cube root of their weights. Taking as a fair figure that obtained from the larger bird, I find that a man of ordinary weight should be able to fly with wings having an area of only about 40 square feet (nearly 4 sq. m.). De Villeneuve states that a bat having the weight of a man would need wings only ten feet (3 meters nearly) long. Hastings makes the surface of each wing from 5 to 10 times $\frac{3}{5}\sqrt{W}$ where the area is measured in square centimeters and the weight in grammes. Marey has made birds in harness record graphically the motions of their own wings, and Haughton and Marey and others have determined the working power of muscles in proportion to weight and size, and the method of movement of muscles and wing.

Henson, Stringfellow, May, and others have made self-impelling model flying-machines, some of which have actually lifted themselves in the air, and several of which have flown with great speed when once lifted clear of the ground. But the most remarkable achievement of all, perhaps, is that of Henson in making a steam engine, fragile to be sure, but still a working machine, producing a third of a horse-power, and weighing *less than* 15 *pounds* (6½ kilogs.). This machine was certainly more powerful than any bird of its weight could be. It is here that we seem most likely to be held in check, and it must be confessed that there is as yet but little on which to base an expectation of finding a satisfactory yet powerful motor.

Thus we are apparently approaching, though still, perhaps, far from this goal, and we may barely venture to hope that the engineer who is to combine the elements of success, all of which are becoming determined, will in our own day win the fame that awaits the first successful builder of a flying machine.

IMPROVEMENTS IN PRINTING.

But all the efforts during this most wonderful of centuries just passing, of either men of science, or of engineers, would have been of little avail in the world, would have been unfruitful, however intelligent and however energetic the workers, without that other mighty power which preserves all science and sustains all art, which perpetuates both the fame of the inventor and the knowledge of his inventions. The art of printing, originating in an unknown past, dating its first grand expansion from the time of Gutenberg, and the use of movable types, four centuries ago, has seen its grandest development during this last half century.

The introduction of the power press and the gradual incorporation into one automatic machine of the web-perfecting press of Sir Rowland Hill and of Jephtha Wilkinson's of Worms' cylindrical stereotype plates, of Richard Hoe's type-cylinder and double-acting fly-frame; of Applegarth's enlarged impression-cylinder, and of minor improvements have led to the creation of the modern press.

To-day a daily paper can be printed at the rate of 30,000 impressions an hour, each paper printed on both sides, cut from the great roll—hundreds of yards long—in which it came to the press, pasted in shape and folded exactly to size, and then counted off by the machine as delivered to the carrier.

Of all the observable signs of progress that attract our attention in these stirring times none are more interesting, and none more vitally important, than those which indicate the progress of this nation and of the world in the means and the methods of preparing the coming generation for its work.

THE WORKING POWER OF WEALTH.

The accumulation of wealth depends upon our material progress, and constitutes the only means of securing a steady progression in civilization, of conferring upon the world the blessings of intellectual and moral advancement, and of comfort and healthful luxury. But the accumulation of wealth means, not the piling of gold and silver in treasury vaults, and not the aggregation of fictitious values in Wall Street, but the production of real property in buildings, in enriched lands, in mill machinery, in means of transportation, and in every form of durable material essential to the creature comforts of mankind.

The accumulation of real property depends largely, if not almost entirely, upon two great social conditions—the cheapening of food and other destructible necessaries of human life by the introduction of labor-saving mechanisms and processes, and the steady and skillful application of the intellect and of the manual skill thus set at liberty, to the production of that form of permanent wealth the accumulation of which during the past century has given to the working-man of to-day comforts and luxuries unknown to kings and princes on the day of the birth of our country.

EDUCATION.

Now, all that can be done in this direction must be done principally by the mechanic and the engineer, and our immediate duty is to see to it that our children and our children's children shall have every opportunity to acquire that knowledge and that intellectual power, and to gain those means and powers of directing the forces of nature as well as to utilize their own natural strength and skill, and thus to do this work when the opportunity comes to them, with highest success and most thorough efficiency. It is in providing the opportunity demanded by every good citizen to make his sons and his daughters capable of doing the work so coming to them that the highest duties of the State remain to be fulfilled, and here it is that the signs of the times are most cheering.

When every man and woman, every boy and girl in the land is guaranteed the privilege of learning any business, and of engaging in any occupation that he or she chooses, or that circumstances may render advisable, and whenever and wherever it may seem best, a long step in advance will have been taken.

TRADE SCHOOLS.

But the individual must be taught, not simply *permitted* to learn as best he can. Education, directed effectively with the object of giving, in least time and at least cost, a preparation for all the duties coming to the learner, whether in daily toil or in social life, is called for; trade schools must be incorporated into the common school system, and technical and professional colleges and great *universities of science and art* must be placed beside the older academies of learning. And this need is most felt by our own colleagues, and by the people employed by them. He who would accomplish most in the profession of the mechanical engineer, or in the trades, must best combine scientific attainments—and especially experimental knowledge—with mechanical taste and ability, and with a good judgment ripened by large experience. He must be carefully, thoroughly, and skillfully taught the principles of his art in the technical school, and the practice of his profession in office or workshop.

We have been late in seeing this necessity, and must suffer for our dullness as a nation; but we are beginning to open our eyes and to move in this most vital of all the duties of citizenship. One and two and three centuries ago, wise men like Pascal and Worcester and Vaucanson saw this greatest, highest duty of governments and citizenship, but it is only recently that we, as a people, have come to see its importance.

But now, the magnificent trade and technical school system of Germany, the older if less complete educational system of France, the tardily begun but splendid later work of Great Britain, and the grand beginnings made in the United States form a glorious commencement of a revolution that shall peacefully effect such changes during the next generation as, probably, no one can realize until after their actual accomplishment.

With trade schools in every town, technical schools in every city, colleges of science and the arts in every State, and with a great technical university as a center for the whole system, we shall yet see all combined in a social organization that shall insure to every one absolute freedom to learn and to labor in any department of industry, with absolute certainty of a fitting recompense for all the zeal, intelligence, and good work that the worker, whether man or woman, may offer the world. Then, and then only, will the memory of those greatest benefactors of their race, Case and Hoe, Vasser and Durant, Rensselaer and Rose, Stevens and Packer, Pardee and Washburn be generally revered as we to-day revere them.

Then, and then only, will our profession attain its noblest development, and its science and its art, in closest union, aid most gloriously in the great work of emancipating mankind from the trammels of this animal nature, and of relieving the race from the pressure now felt in the terrible struggle for the necessities of life, substituting arms of iron and fingers of steel for these weak members of flesh to do the work of the world, leaving every human being having brains the opportunity to acquire knowledge, to enjoy life, liberty, and the pursuit of happiness and to prepare for the future, as the knowledge, judgment, and faith of the individual may dictate.

STEAM WAGONS.

THE Colusa *Sun* says: "After all his experiments, Captain Roberts, of the San Joaquin Company, is still an enthusiast about his steam wagon enterprise. We had a conversation with him some time ago, and he thinks that roads suitable for his wagon can be built very cheaply. He thinks of digging two small graded ditches and filling with gravel, which will pack as hard as iron, and give a solid road for each of the broad wheels, and for the wagon wheels that follow with the loads. Its weight is 17 or 18 tons, and it is calculated to haul 50 tons of grain at each trip. It will be taken to the Upper Sacramento valley, and will engage in grain hauling between Riceville and McIntosh's Landing.

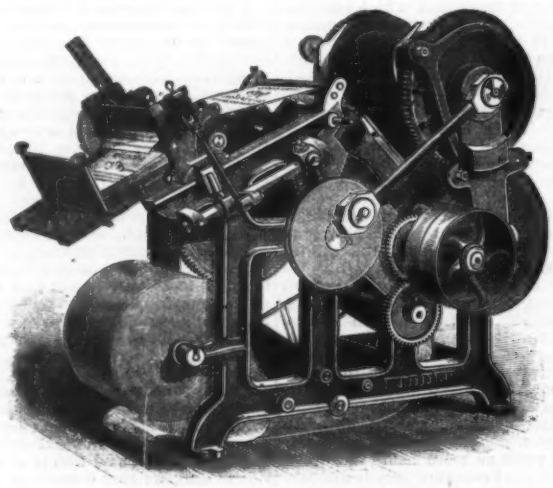
"Captain Roberts will, if this one shall prove the success he anticipates, put on wagons to run to all the principal landings on the river, and thus cross-section the entire Sacramento valley. He will have effected a freight railroad across the valley from foothill to river, every eight or ten miles."

IMPROVED EXPANSIBLE PULLEY.

THE improved expansible pulley, shown in section and elevation in the annexed cut, is the invention of Mr. Herrman Schulte, the manager of an Austrian paper mill. The special advantage of this pulley is its great simplicity in construction and operation. It consists of a box or hub, A, fixed o nthe shaft, and provided with arms, having apertures at the ends through which the spokes of the pulley pass, the ends of these arms being united by a ring, *b*. A cone, C, which revolves with the shaft but can be adjusted longitudinally on the same, is provided in its outer surface with longitudinal dovetailed grooves, in which the ends of the spokes of the pulley can slide. This cone is provided with an annular groove, for receiving a collar, E. A fly-wheel, D, is mounted loosely on the shaft, and is provided with a screw, *d*, and an opposite guide rod, *f*, both extending into the collar. By turning the hexagonal head of the screw, *d*, the diameter of the pulley can be increased or decreased more or less accordingly as the ends of the spokes slide up or down the grooves of the cone, C.—*Chronique Industrielle.*

THE KIDDER PRINTING PRESS.

OUR attention has recently been directed to a novelty in platen printing machines which has reached this country from America. This is the Kidder web job platen press, of which we give a perspective view in the engraving herewith. In this machine the printed work is automatically cut, counted, and delivered in separate sheets or pieces of any required size; or, in the event of the work having to be printed on both sides, the knife is disconnected and the sheet passes through to be rewound in a roll ready for printing on the other side. A speed is guaranteed of from 3,500 to 6,000 per hour; forms are made ready and started as quickly as on any other small platen machine; and the ink distribution is double, it being so arranged if desired that the whole four-form rollers pass twice over the form at each impression and take up fresh ink both coming and returning, or at both sides of the form, thus insuring even depth of color throughout. A floor space of four by five feet affords ample room for its effective operation. By means of attachments which are easily fitted, the Kidder press can be made to fulfill the part of a ruling machine to any work requiring it, and of a bronzing machine, both operations being carried on simultaneously with the printing, and it can be adapted for printing two colors at one and the same operation in any combination which is now ordinarily done at two different impressions. We first saw this useful little press at work in the late Exhibition of Printing Machinery, and we subsequently met with it at the Manufacturers' Exhibition of Machinery, 18 and 19 Blomfield Street, London Wall (where it is still on view), and can speak well of its performances. The machine represented in our engraving is an eighth medium, and at present other sizes are made, namely, half-medium, 14 by 19, and a quarto, 10 by 22. The machine certainly marks a step in advance as regards the saving of labor in printing processes.—*Iron.*



THE KIDDER PRINTING PRESS.

THE TELELOGUE.

CAPT. GAUMET'S NEW APPARATUS FOR OPTICAL TELEGRAPHY.

EXPERIENCE has shown that the visibility of signals observed at a great distance depends especially upon the contrast occasioned by the difference between the brilliancy of the signals and that of the background from which they detach themselves.

Up to the present time this contrast, which is necessary in order to show the form of the signals, has been obtained in aerial telegraphy by the use of opaque bodies displayed against the bright sky as a background. Such is the principle which served as a base for the apparatus described before the Royal Society of London in 1684 by the celebrated Robert Hooke, and which consisted of a system of signals formed of boards of different shapes, painted black, that could be raised in the middle of a frame. At about the same period Amonton presented to the Académie des Sciences an apparatus constructed on the same principle and differing but little from Hooke's system. This same principle has also served as a basis for Chappe's telegraph, which is employed for the signals at great distances in use in the navy.

The necessity of causing signals painted black to show against the sky requires the apparatus for displaying them to be erected on culminating points and at certain elevations above the earth. To obtain these results it becomes necessary to have recourse to large and heavy apparatus.

What characterizes the telelogue is that, in this system, the difference of brilliancy necessary to bring out clearly the form of the signals is obtained by the use of a silvered surface detaching itself from a dead black background.

It is only necessary to incline the apparatus slightly to cause the silvered surface to assume great brilliancy, due to the diffusion and to the reflection on the silver of the sky's diffused light.

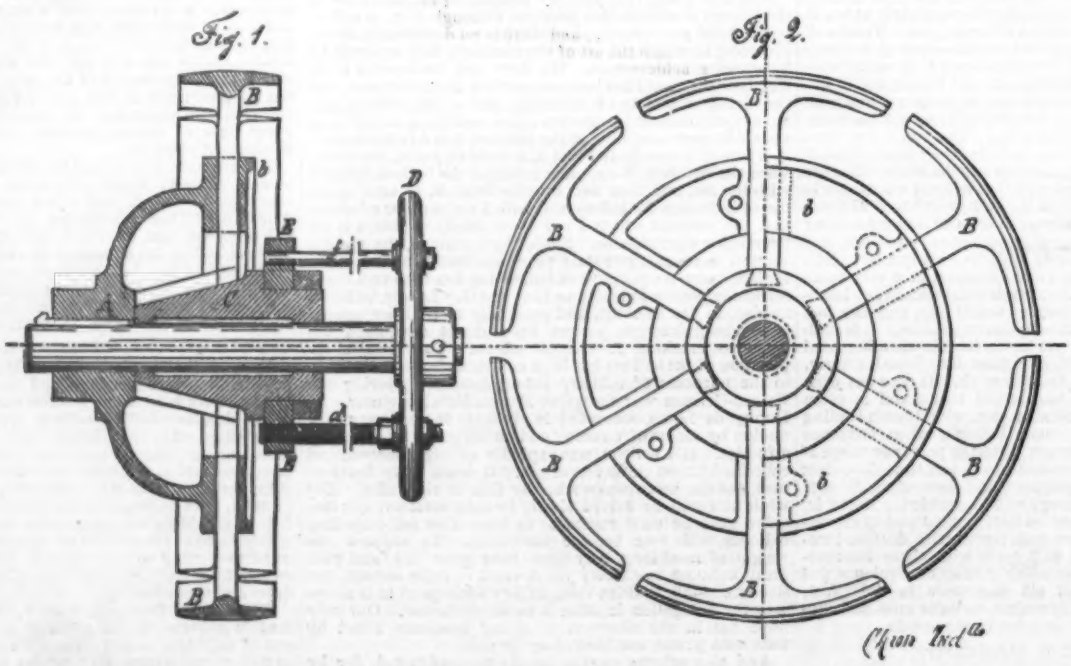
In the apparatus which he has invented, Capt. Gaumet has chosen alphabetical and numerical characters as signals, taking for his basis the well-known fact that the signals that are most easily recognized at great distances are precisely those that one is accustomed to see close by.

DESCRIPTION OF THE TELELOGUE.

The preceding considerations have served as a basis for the construction of the telelogue, which may be described as follows:

The apparatus comprehends two essential parts: (1) the *telegraphic album*, or signal-book, serving as a manipulator; and (2) a *spy glass* or receiving telescope.

The telegraphic album is formed of forty sheets of dead-black linen cloth, to which are affixed the silvered signals. In order to utilize the dimensions of the album in such a manner as to have the signals as large as possible, each of the latter is made to occupy the reverse of one sheet and the



IMPROVED EXPANSIBLE PULLEY.

obverse of the one following. Each sheet has on its outer edge an index which permits of quickly finding the signal that it is desired to display.

The signals include the twenty-four letters of the alphabet, the ten numerals, and some other signs employed for facilitating communications. The form of the alphabetical and numerical characters has been chosen in such a way as to obtain the greatest range of visibility. The complementary signals consist, (1), of a warning signal in the shape of a silvered rectangle, and (2), of conventional signals utilized for the needs of communication.

The covering of the album consists of two stiff sides connected together by a very simple arrangement in such a way as to form a tablet.

One of these sides is provided at its extremities with two rods serving as supports, and these, along with a third, constitute a tripod, which facilitates the immediate setting up of the apparatus and at the same time permits of its being given the amount of inclination desired.

The second part of the apparatus consists of a spy-glass serving as a receiving telescope. For this purpose an instrument has been specially constructed which, while being of

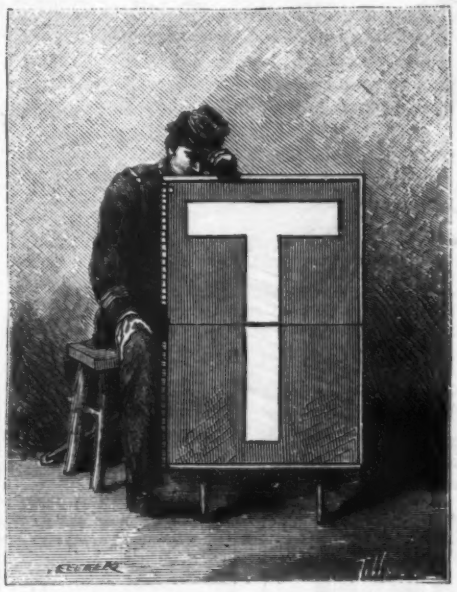


FIG. 1.—CAPT. GAUMET'S TELELOGUE.

small compass and light weight, possesses considerable magnifying power combined with very great clearness.

The great magnifying power of the instrument requires that it shall be very stably supported; and a very simple arrangement allows of the album tripod being utilized for that purpose.

The dimensions of the album and the power of the spy-glass vary according to the maximum distance separating the transmitting and receiving stations. According to their range, the apparatus to be employed include:

1.—*Short Range Apparatus*, permitting of corresponding at a maximum distance of two and a half miles. The album measures 13 by 18 inches, and the receiving apparatus is a field-glass. The weight of the apparatus, including the field glass, does not exceed four and a half pounds.

2.—*Medium Range Apparatus*, the maximum distance of which may reach five miles. In this case the dimensions of the album are 28 by 20 inches, and the spy-glass has a considerably greater magnifying power than the preceding. The weight of the album and glass together is less than seventeen pounds.

3.—*Long Range Apparatus* by means of which a range of seven and a half miles may be attained. In certain countries that have a very pure atmosphere, such as the middle of France, Italy, Spain, Greece, etc., the last-named range may, in many cases, be doubled or even tripled.

It is hardly necessary to say that, in this case, the dimensions of the album, although increased, do not reach such a size as to render the apparatus difficult of management. The efficiency of the apparatus in this case is attained by the use of telescopes or spy-glasses of quite a high magnifying power.

Night Apparatus.—In order that it may be used at night, the telelogue requires the addition of a luminous source of sufficient intensity to illuminate the signals and render them brilliant. Experience has shown that a large kerosene lamp, furnished with a reflector, is generally sufficient for corresponding at short distances. For greater ranges it is necessary to employ two lamps. It is scarcely necessary to say that on every occasion when there is at disposal a very powerful light, such as the electric or calcium light, it will prove advantageous to make use of it.

METHOD OF USING THE TELELOGUE.

Let us suppose that the distance between the two stations is known, and that each of them is provided with an apparatus suitable for corresponding at this distance; the apparatus will be maneuvered as follows:

The album is opened and the two parts of the cover are joined in such a way as to form an inflexible tablet; the metallic rod which, with the two rods of the cover, forms the tripod, is fixed in position; and the album is then made to exactly face the receiving station. Then the apparatus is given a slight inclination in such a way as to cause the silvered signals to be illuminated by the sky, and to appear very brilliant in the direction of the receiving station. The spy-glass is next pointed exactly toward the receiving station.

The apparatus being thus arranged, the silvered rectangle is displayed, producing at a distance the effect of a brilliant point; this is the premonitory signal.

As soon as the signal has been perceived at the other station, by means of the receiving spy-glass, it is repeated by the receiving station to indicate to the sender that all is in readiness for the reception of the dispatch. The transmission of the latter then begins, and is effected as follows:

The different letters composing the telegram are displayed in succession, the index being made use of for immediately finding the proper signal. Each word is separated by the silvered rectangle. When a signal is to be repeated, for example, in the case of the doubling of a letter or numeral, it is covered after the first display by a black sheet, and then displayed anew. The end of each phrase is marked by the repetition of the silvered rectangular signal.

The telegram is received by the aid of the spy-glass. The observer, located at the receiving station, sees the letters composing the telegram succeed each other in the field of the glass, and dictates them in a loud voice to an aid who inscribes them, or else he writes them down himself at the moment he perceives them.

In fact, the observer located at the receiving post *spells at a great distance* the dispatch which is sent him by the other station.

It is readily conceived that the image produced on the retina by characters located at great distances, but having large dimensions still further increased by the magnification of a field-glass, is the same as that produced by reading the printed characters in a newspaper or book; the loss of light, due to the resistance of the atmospheric medium and to magnification by the spy-glass, being compensated for by the use of signals of great brilliancy.

The velocity of light being infinitely great, each signal is perceived at the very moment it appears; and, as a result of this, then, the speed of transmission will depend solely upon the rapidity with which the different signals are displayed. Experiment has shown that a dispatch of twenty words may be transmitted in five minutes, each word being sent with all the letters which compose it. The speed of transmission may be considerably increased, if, instead of taking for each signal its usually admitted signification, there be adopted a conventional value fixed by a vocabulary. By using in connection with the telelogue Chappe's ingenious vocabulary, the speed of transmission may be more than doubled.

To Render Correspondence Secret.—In the use of telelogues, cases may occur in which the dispatch transmitted runs the risk of being intercepted, or in which it is desired to avoid a chance of any indiscreetness on the part of the person employed in sending the telegram. The following methods may be employed to meet such exigencies:

By arranging to the right and left of the album two black cloths, the field of visibility of the apparatus from the receiving station will be limited. Absolute security may be attained in the exchange of telegrams by making use of several of such processes of cryptography as are possible with the telelogue, such as substituting one letter of the alphabet for another, etc.

The applications of which an apparatus like this are susceptible may be included in two categories; general applications, and applications for military purposes.

GENERAL APPLICATIONS.

The electric telegraph, which establishes rapid communication between the principal centers, cannot be ramified to infinity, and we could not reasonably expect to connect the smaller localities of a country by that means. The erection of a telegraph line and keeping it in repair is always very costly, and, moreover, this mode of communication requires special employés who must receive good compensation. It is due to such considerations that only those places are connected by wires which are of sufficient importance to afford by their business the necessary profit to pay the expenses of offices, operators, etc.

There is no need, then, of dwelling upon the great advantages that are to be gained by the use of an apparatus of the greatest simplicity, of a moderate price, and whose management can be confided to a child, for affording means of a rapid communication between numerous villages which are completely deprived of such means. The advantages are especially striking as regards localities whose topographical situation allows of a direct optical connection; that is to say, all localities visible one from another. For this, it would be sufficient that there should exist in such places, or near them, a position which should allow the locality to be seen with which it was desired to correspond. The bell-tower, owing to its elevated position, would often be indicated as a telegraphic station.

If we cast our eyes over our map we shall at once take in thousands of localities which might thus be connected with each other by means of the simple apparatus that we have just described. It is in mountainous countries especially that the telelogue will be called upon to render the greatest services. There, in fact, communications are most difficult; roadways are of immoderate length; and it often happens that a person going from one point to another has to travel a distance which is double or even treble that which separates the two places in a bee-line. The use of the telelogue in such cases would often prevent the necessity of the fatigue of a journey and a loss of time. And such results might be obtained by the use of an apparatus weighing less than five pounds. A large number of elevated localities on the two sides of a valley might thus be very easily connected by means of the telelogue. Communication between such localties is often restricted by the presence of a water-course whose width offers considerable of an obstacle, and the wider the stream the fewer are the bridges for crossing it. Here again, for a distance which, in a bee-line would be two to two and a half miles, one has often to travel four or five (Fig. 2).

APPLICATION OF THE TELELOGUE FOR MILITARY PURPOSES.

In times of peace the apparatus will serve to connect the different parts of a scattered body of troops occupying not very distant positions. It may also be employed on rifle ranges, and will prove of especial value in connecting the different detachments of a body of troops maneuvering over a considerable extent of ground. In time of war the apparatus will be used for connecting forts with each other, and for service on marches and at outposts and in military reconnaissances, etc. It has already received the sanction of experience, and has recently been publicly experimented with in presence of a large number of scientific and military experts. Telegraphic communications were instantaneously established between the Trocadero, the Pantheon, the Tuileries, and the Military School, and gave the best results in spite of the rain and mist.—*La Nature.*

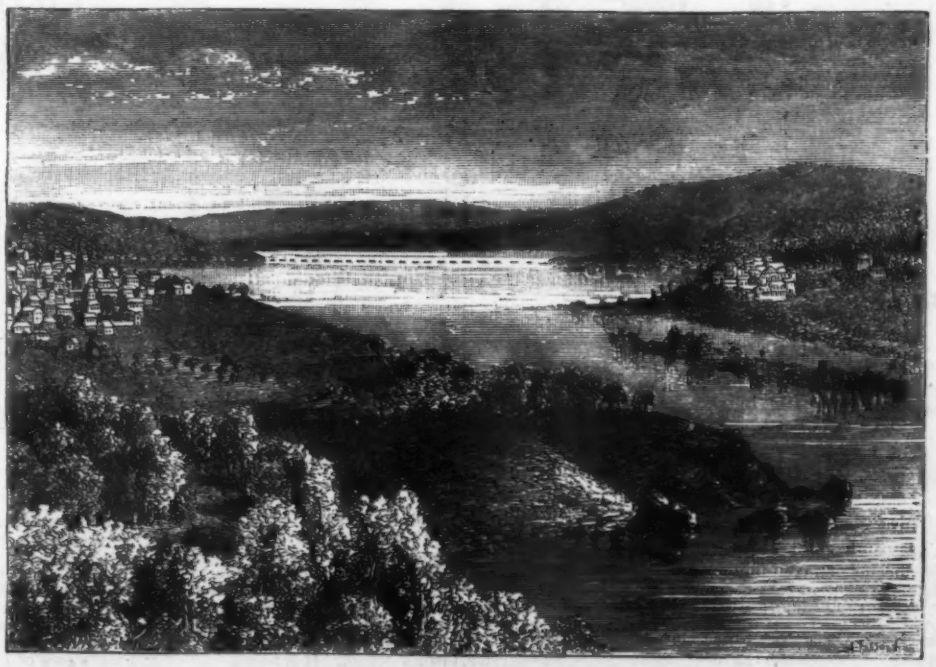


FIG. 2.—APPLICATION OF THE TELELOGUE.

Showing how two localities on the opposite banks of a river may be put in communication. The dotted line shows the track of the visual ray.

NEW ASTATIC GALVANOMETER.

By MARCEL DEPREZ.

THE galvanometer for giving indications with rapidity, which I made known about two years ago, is perfectly adapted for measuring the currents that are employed for industrial purposes, such as electric lighting, motive power, electro metallurgy, etc.; but it is not sufficiently sensitive for scientific researches, because the very rapidity of its indications requires that the antagonistic force which repels the needle shall be relatively great. When great sensitiveness is required we have necessarily to proceed in the direction of astaticity, that is to say, make the directing force very weak, while at the same time preserving in the magnetized needle (called "fish-bone") as strong a magnetization as possible.

In order to satisfy these two conditions, which at first sight seem to be irreconcilable, Mr. D'Arsonval has had the happy thought to modify my galvanometer in such a way as not to change the number of its parts, but to permit of rendering the antagonistic force as weak as desirable, while at the same increasing the mechanical action of the current upon the needle. Mr. D'Arsonval was led to make this arrangement by remarking that this mechanical action was accompanied by an equal and contrary reaction of the needle upon the current, and that, consequently, if we fix the needle and make the current movable we do not alter the momentum of the thrust exerted by the galvanometric helix upon the needle, while the antagonistic effect is annulled. It is easily seen that the force which tends to cause the helix to move is greater than that which is exerted by the helix upon the needle, because the helix is, in addition, urged to move in the same direction by the permanent magnet within which it is inclosed.

This modification ranks the instrument in that class of apparatus which utilize the action of a powerful magnetic field upon a current whose direction is perpendicular to the lines of forces of the field, and among which I may cite the movable bobbin of Thomson's siphon recorder, and my previously-described current measurer. But the arrangement and relative proportions of the different parts of which it is composed, and the complete utilization and concentration of the magnetic field of the magnet, make it an apparatus in which small dimensions are reconciled with a powerful magnetic action of the current traversing it. Before entering upon a description of it, I ought to say that a few very simple considerations have led me to substitute for the "fish-bone" (which Mr. D'Arsonval wished to retain in it) an iron tube.

The instrument, which is shown in the accompanying engraving, consists of four parts:

(1.) A permanent magnet, weighing about 700 grammes, A A, and the arms of which are about 30 millimeters apart.

(2.) A tube of soft iron, B, occupying almost the entire length of the magnet, and having a diameter of about 25 millimeters.

(3.) A helix, C D E C, movable at E and J, around two knife-blades whose edges coincide with the axis of the tube and are supported by the post, G. This helix receives the current through two wires, I I, whose extremities coincide likewise with the axis of the tube (in such a way as to remain at rest when the helix revolves) and dip into mercury cups, H.

(4.) A needle, E F, of straw, moving in front of a graduated dial.

The necessary weakness of force to prevent the apparatus becoming completely astatic is obtained by slightly lowering the center of gravity of the entire movable portion beneath the edge of the knife-blades, so that its oscillations under the action of gravity shall have a duration of about a second.

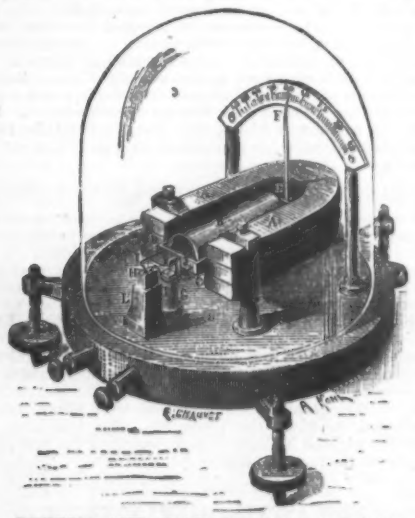
The movable system weighs about 2½ grammes.

When the apparatus is properly regulated and the mercury in the cups is very pure its sensitiveness is comparable with that of the ordinary astatic needle and silk-thread galvanometers, while it is infinitely easier to use and more transportable. Its indications, moreover, are in no wise influenced by magnetic bodies which chance to be in its vicinity. The galvanometric helix, C D E C, may be constructed either of a continuous strip of metal or of a very long fine wire wound around many times. In the first case (which is that shown in the figure) the instrument is adapted for measuring currents produced by a very weak electromotive force in a very slightly resistant circuit, such as thermo-electric currents. In the second case it is utilized for detecting the passage of very weak currents traversing an extremely resistant circuit.

Some idea of its extreme sensitiveness may be obtained as follows:

(1.) Connect the two terminals of the instrument by means of a copper wire 1½ to 2 millimeters in diameter and 100 millimeters long, slightly bent so as to form a ring for holding a small straight magnet or a well-magnetized knitting-needle. This done, the needle of the galvanometer will be observed to deviate at once by several degrees and then immediately return to zero. In this way evidence is given of a current induced in a wire 10 centimeters in length by a straight magnet of the dimensions of a knitting-needle.

(2.) Substitute for the non-resistant helix another com-



DEPREZ AND D'ARSONVAL'S ASTATIC GALVANOMETER.

posed of a wire one-tenth of a millimeter in diameter and wound around about 150 times, and place it in an electric circuit in which there are interposed several persons holding each other by the hand. If into this circuit, whose resistance is from forty to fifty thousand ohms, there be sent a current from one element of a Daniell battery, the needle will immediately deviate from 15 to 20 degrees.

Finally, when the helix oscillates (after the current is broken), it is only necessary to unite the two terminals of the apparatus by a wire to cause the needle to slowly return to zero without the power of going beyond it. This phenomenon is due to the fact that the helix, in moving in an intense magnetic field, develops of itself induced currents whose mechanical action tends to bring it to a state of rest. This property renders it valuable for measuring resistances.

THE ELECTRIC DISCHARGE THROUGH COLZA OIL.*

By A. MACFARLANE, D.Sc., F.R.S.E.

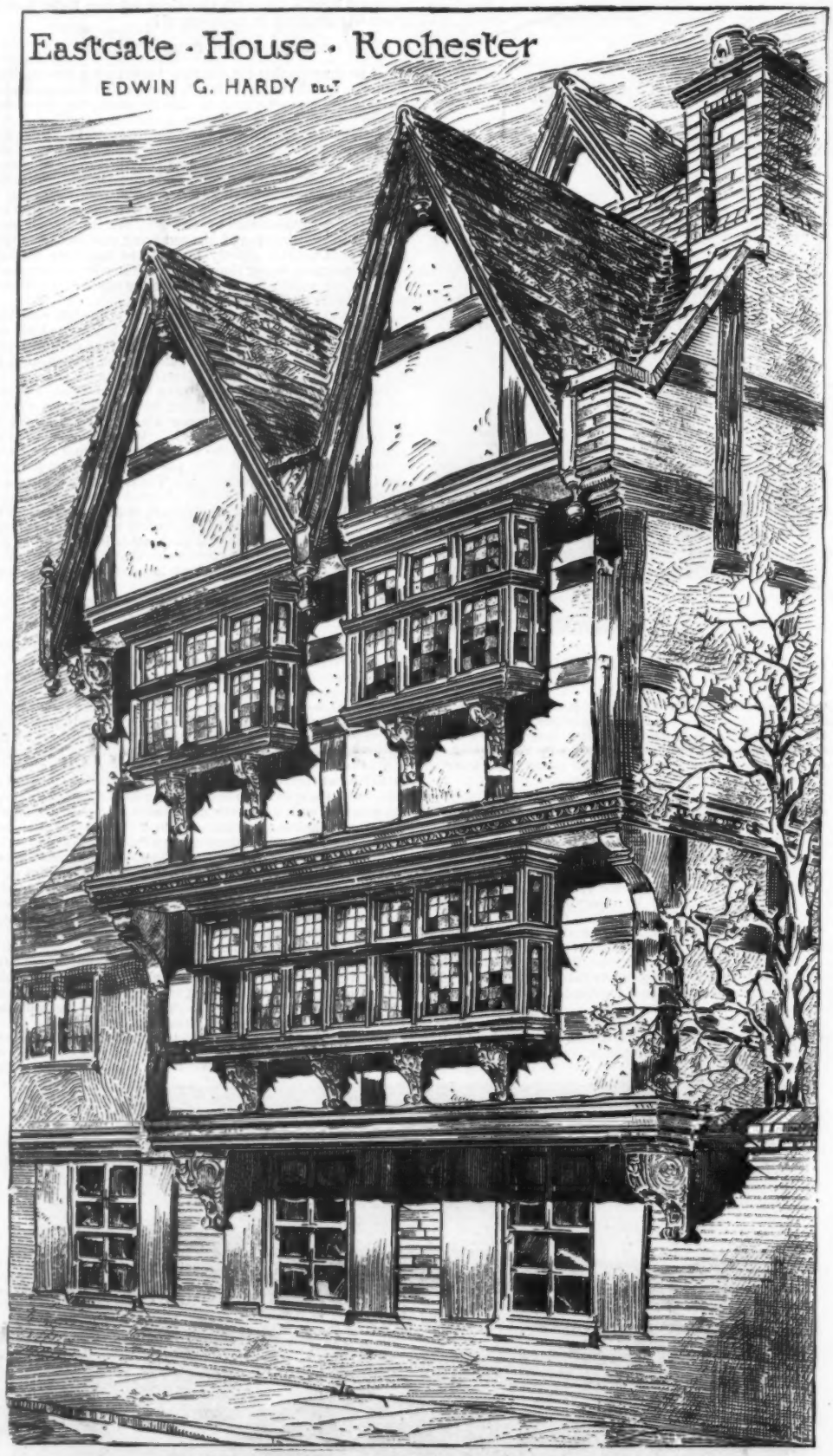
THE electric properties of colza oil which I have examined are its dielectric strength and some phenomena which accompany the passage of the spark. By the dielectric strength of a substance I mean the ratio of the difference of potential required to pass a spark through the substance to that required to pass a spark through air under the same conditions. The electrodes used were two parallel brass plates each four inches in diameter. When comparing the gases the standard distance of the plates chosen was 5 mm. In the case of liquids it is convenient to observe for a shorter distance, and reduce the result by the law which previous experiments of mine have established, namely, that in the case of the discharge between parallel plates through a liquid dielectric the difference of potential required is proportional to the distance between the plates. (Trans. R. S. E., vol xxix., p. 563.) One set of observations gave the ratio for colza oil to be 2·7; another gave 2·5. Hence 2·6 may be taken. I have now obtained the following table of dielectric strengths for liquids (air being unity):

Substance.	Dielectric strength.
Paraffin oil	3·7
Oil of turpentine	4
Paraffin (liquefied)	2·4
Olive oil	3·5
Colza oil	2·6

The specific gravity of the colza oil is 0·91.

* A paper read at the British Association, 1881.

The passage of the spark was accompanied by the formation of gas bubbles, but there was no deposition of solid particles. As the four-inch plates were placed horizontally in the oil, a bubble produced by a discharge was prevented from escaping by the upper plate. When the upper plate is again electrified, such a bubble behaves in the following manner: If it is large enough it will extend itself somewhat like an hour glass between the plates, but if it is smaller it takes the form of an acorn with a flat base, the base resting on one or other of the plates. When the upper plate is charged positively, the bubble is repelled so as to place its base on the lower plate; when the electricity is changed to negative the bubble remains with its base on the upper plate. A reversal of the order of the charging did not change the effect.



SUGGESTIONS IN ARCHITECTURE.—EASTGATE HOUSE.

After a few electrifications a sufficient number of solid particles collects to form a chain, and this interferes with the phenomenon, the bubbles then being lengthened out in a remarkable manner, but never repelled to the lower plate. When the upper plate was charged negatively, gas bubbles appeared to me to rise from the lower plate, as if they had been formed there. To test this point further I took some sparks between two smaller disks placed vertically in the oil. The gas bubbles were observed to rise up at the negative surface, as if they had been formed at the positive surface, had been repelled or carried straight across, and then rose up at the negative surface. When the spark was taken between two points bent at right angles to two rods dipping into the oil the bubbles were observed to shoot out in the direction from the positively charged point, and to circulate round the earth-rod some time before rising to the surface. These phenomena indicate that the bubble is positively electrified.

EASTGATE HOUSE, ROCHESTER.

THE old half-timbered house from Rochester, which we illustrate to-day, is Elizabethan or Jacobean in style and date; it is situated at the eastern end of the principal street of the town, and nearly opposite a splendid block of buildings of similar date, now used as shops, a view of which we published a few years back. The interior of Eastgate House is, taken altogether, fairly complete, and in a good state of preservation. The effect of the principal staircase, with the windows placed high up, is exceedingly good. Several of the rooms have their old original paneling, and some their ornamental plaster ceiling. The one in room on first floor looking into the street is especially worthy of notice. The long window of this apartment is shown in our drawing. The upper rooms have paneled dadoes about 3 feet 6 inches high. Till recently the house was used as a ladies' school. It is now inhabited and taken care of by an appreciative owner. The sketch which we publish is from the pencil of Mr. Edwin G. Hardy, whose same drawing was exhibited in this year's Royal Academy Exhibition.—*Building News*

THE NEW BUILDINGS FOR THE MEDICAL DEPARTMENT OF THE UNIVERSITY OF HALLE A. S., GERMANY.

VERY extensive buildings have been erected for the medical department of the university of Halle a. S. in Germany, which, when completed, will leave this university with the largest and most complete clinical institution in Germany, if not in the world. A birdseye view of these buildings is shown in the annexed cut. On the extreme left the buildings for the clinic for females and the residence of the director or president of the institution are located. The buildings for the female clinic consist of a lying-in house, a building for the gynecological clinic, and lecture rooms, which are located between the above mentioned two buildings. Behind the same are located the buildings for the medical or internal clinic, consisting of a central lecture room building, and at the right and left thereof a two-story hospital ward building, one of them for males and the other for females. A short distance behind these buildings there is a building known as a "block," consisting of a single story building without partitions and with windows in both sides, so that it will be ventilated better than any other building provided with ventilating apparatus. Far away in the background and hardly visible in the engraving, the isolated building for contagious diseases is located. Passing along Magdeburg street we find the buildings for the administration and the steward, which are provided with the most improved steam cooking and washing apparatus. Next to these we find the buildings for the surgical clinic, which consist of a central building containing lecture rooms and a hall for surgical operations, and of four blocks, of which two are for adult males, one for adult females, and the fourth for children. Adjoining these buildings we find the buildings for the eye and ear clinic. Behind the buildings for the surgical clinic are located two pavilions or wards to be used for the medical and surgical clinics, and between these the chapel. Further we find the buildings for the pathological and physiological clinics, and the anatomical institute, the magnificent and extensive museum of which occupies more than one half of the building. The large tower behind the steward's building contains two large sheet-iron smokestacks, through which the smoke and products of combustion of ten steam boilers pass, thereby creating a strong draught in the tower, which is connected by large channels with the several wards, rooms, and buildings of the institution, which are thus thoroughly ventilated. The building material used throughout is brick of a light yellow color, with mosaic brick for ornamentation.

FLEXIBILITY OF MARBLE.

ELASTICITY is a general property of matter, but its manifestations are very variable according to the form of bodies and the nature of the stress exerted. Thus, a crystal ball will rebound to a great height from a pavement, and a thread of glass has all the flexibility of silk; but that does not prevent us from commonly saying "as fragile as glass," because of the common accidents that we see in daily usage. The rigidity of marble has served as a subject from the remotest times for the metaphors of all poets; and I do not know that a single architect has ever foreseen that a slab of stone might bend and act like a fir plank without flying into fragments. This, however, is something that may at present be seen at the palace of the Alhambra, at Granada, as one detail lost among the thousands of wonders of that enchanting maze. One of the two doors that have been christened *La Mezquita* (probably because near by there is an old unfinished chapel of the time of Philip V.) exhibits an ancient facing of three slabs of marble, the upper resting as a lintel upon the two others, which form uprights 11 feet in height, 9 inches in width, and only 2¾ inches thick.

If we compare this door with that to the left, we at once remark that it is much smaller, having been diminished on every side, not only by the thickness of the white marble, but also by a thick layer of plaster beginning at the point where the old facing of tiles is set in.

Now, whoever has had an opportunity of admiring the mathematical precision of Arabic structure cannot possibly doubt that all this has evidently been added too late to remedy a subsidence of which evidence is still to be seen in several cracks in the upper wall.

But nothing resists certain stresses, and an enormous thrust upon the right must have been the sudden cause of

PUERTA DE LA MEZQUITA; ALHAMBRA.

(G.—The bent marble stile of the door-frame.)

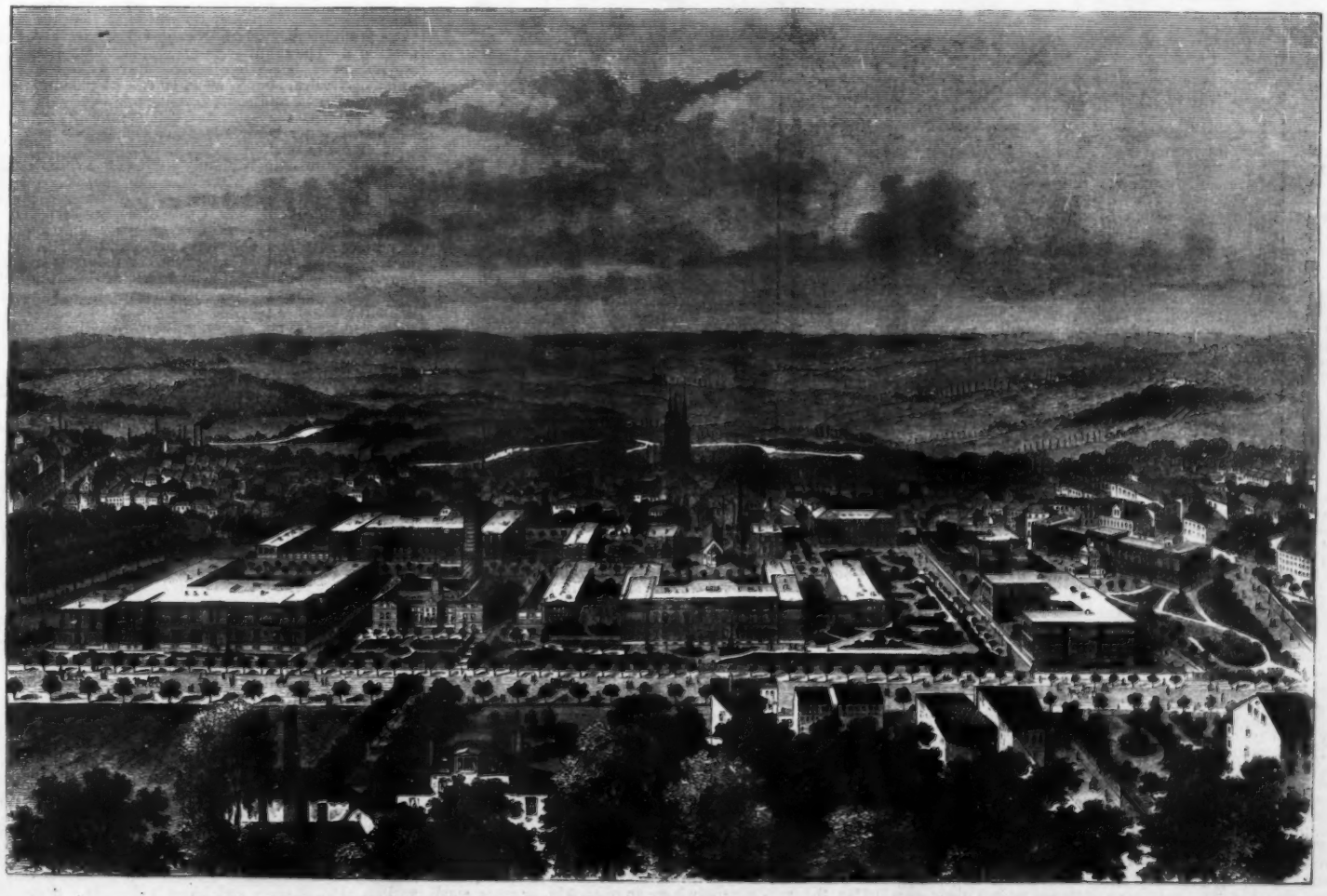
the rising of this side as well as that of the upper slab. How comes it, then, that the marble, instead of breaking or of rupturing its casings, has simply bent and curved as if it were wood? How comes it that it has been able to remain thus, like a bent bow, from an epoch which is totally indeterminable, but which, it is quite likely, dates back to the explosion of a powder mill on the other side of the Darro, which, in 1590, destroyed a large portion of Mezouar? What is certain is that the propwork of joists seen in the engraving was put up only at quite a recent date, and during the course of the restorations so fortunately undertaken some few years ago, to bring to light that graceful stucco lacework and those superb mosaics of faience and all those master-pieces of profane art which Christianity had so piously buried under thick layers of plaster of Paris. The setting of vitrified bricks, moreover, was found completely destroyed up to about twelve inches from the top of the door; and it is exactly at eighteen and a half inches that the slab begins to curve and to detach itself from the wall, to attain its greatest distance therefrom of three inches at about three feet from the bottom.

We may ask what would happen if, by any means whatever, the stone bow should be unbent, or one of its extremities be set free and given play, or the other be unloaded of the weight which holds it in place? Would the stone be seen to straighten back like a spring, or would it remain permanently misshapened, or, indeed, would it break in pieces on escaping from the slow and gradual cause which alone has produced in it so singular an effect? Might not there be found in the molecular homogeneousness to which it has evidently owed its resistance to fracture, curious crystalline modifications like those produced artificially by Mr. Walter Spring, by means of great pressure?

Unfortunately we can only place here a series of interrogation points, and we shall esteem ourselves fortunate if some interested reader down there will keep us informed as to anything new that may happen.—*La Nature.*

OPIUM SMOKING IN AMERICA.

FOUR thousand is a moderate estimate of the total number of native American victims to the opium habit, and these, it is estimated, consume one hundred grains of the drug a day. This gives a daily consumption of four hundred thousand grains, or about nineteen thousand pounds during the year. About three drachms of the smoking opium, equivalent to six drachms of the crude drug, make the average quota of a day's consumption, and this much costs from fifty to seventy-five cents. Some who go to perpetual excess, however, have been known to consume as much as one and a quarter pounds during a day. Taking the average, however, it will be found that the man who hankers after the deleterious and short-lived enjoyment of the drug can gratify that foolish taste only at an expense of $200 a year, and the combined indulgence of all American opium smokers will be found to be carried on at a cost of over three-quarters of a million of dollars yearly. And yet this waste is constantly being increased and the ranks of the fools multiplied, notwithstanding that in some States and cities stringent laws, with penalties of heavy fines and imprisonment, have been resorted to to stay the hurtful progress of the habit. Arrests are constantly made in San Francisco under a city ordinance, but, seemingly, without avail, and the vigorous legal prohibition of Nevada effects but little, if any, abatement of the evil. The importations of smoking opium into America have steadily increased during the last ten years. The number of Chinese smokers in the country is estimated at 10,544, and, calculating upon the same estimate as in the American cases, they consume 50,240 pounds of this drug in a year. Combined, the consumption reaches the startling figure of 69,240 pounds, making the cost for the total indulgence the enormous sum of over $2,900,000. A quantity of the opium used is also smuggled, and is not included in the above estimate, and some of it also is impure. The injurious effect of this consumption is thus increased greatly, being bad enough when the pure drug alone is employed, as it leaves 38 per cent. of ash, six grains only of which is enough to paralyze a rabbit when hypodermically injected. The last point to be noted is that the repulsive specter of the emaciated cadaverous creature to be found everywhere among Chinese votaries is seldom, if ever, seen among American opium-smokers. Nor,



THE NEW MEDICAL BUILDINGS, UNIVERSITY OF HALLE, GERMANY.

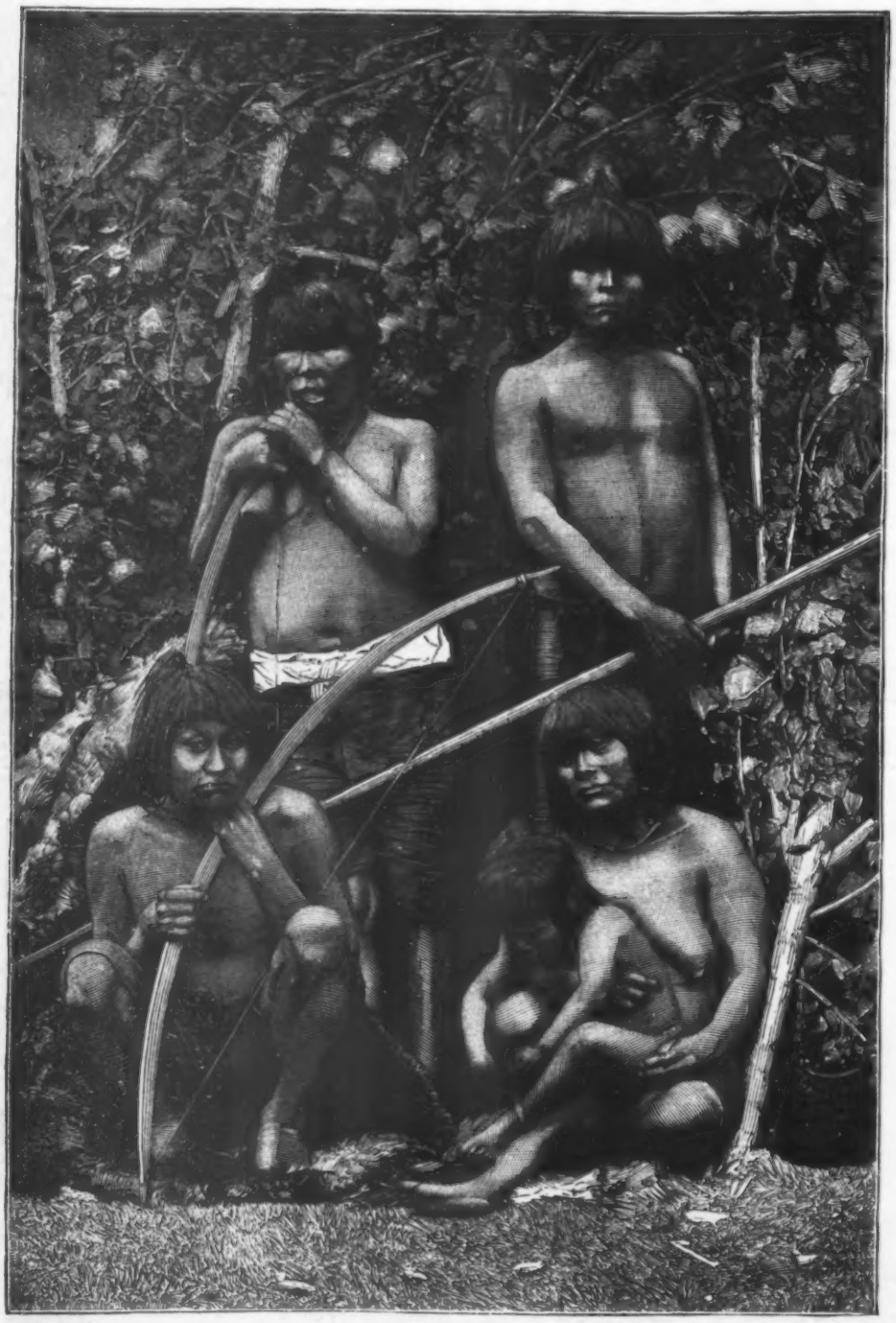
again, is the smoking of the drug so injurious a manner of introducing it into the system as the method of eating it or injecting it hypodermically.—*Times.*

THE FUEGIANS AT THE JARDIN D'ACCLIMATATION, PARIS.

FOR some time past there have been on exhibition at the Jardin d'Acclimatation, at Paris, a party of Fuegians, who have attracted great attention from visitors.

These Fuegians, for such is the name bestowed on them by Capt. Weddel in 1822—a name which has been preserved up to the present time—are inhabitants of Tierra del Fuego. When we read in the works of travelers a description of their country we are no longer surprised at the deep degradation of these people.

Tierra del Fuego is a mountainous archipelago, separated from Patagonia by the Strait of Magellan, and formed of enormous masses of precipitous rocks which leave only narrow beaches for man to dwell upon. In those portions where the rocks are not entirely bare, a thick and impenetrable forest of beech trees covers the sides of the mountains and descends to the ocean. No animal, save a few foxes and birds, inhabits this country. The climate is horrible; the mean summer temperature is, according to King and Darwin, 50° F., and that of winter, 33° F.; there is a perpetual fog, and storms are incessant. There scarcely passes a day that it does not rain, or even snow. To find an acre of level land in any part of the country is very rare; the fact is, Tierra del Fuego is a mountainous land partly submerged in the sea, so that deep inlets and bays occupy the place where valleys should exist.



GROUP OF FUEGIANS AT THE JARDIN D'ACCLIMATATION, PARIS. (From a Photograph.)

The Fuegians have long been known and have been many times described. We borrow from D'Orbigny the description that he gives of them, and which is said by *La Nature*, to which we are indebted for the accompanying engraving, to apply perfectly to the savages now on exhibition in Paris.

Their head, says this author, is pretty big, and their face rounded; they have a short and slightly expanded nose, and small, black, horizontal eyes; their mouth is large, with thick lips, and their very even teeth are white; their ears are small, and their cheek-bones project but slightly. They have but a slight beard, which it is their habit to pluck out. Their hair, like that of all Americans, is black, long, and straight. Their body is thick-set, their breast is broad, and their bowed legs relatively quite short. The women exhibit the same characters as the men, and scarcely possess those proportions that European æsthetics require. Their average height is about 5½ feet. Their language is guttural, and has been compared by Capt. Cook to the sound emitted by a person clearing his throat.

The great naturalist, Charles Darwin, was enabled, during the several months that he passed in their country, to observe their habits, and has given us a picture which, because of its truthfulness, is none the less attractive. From him we borrow the following details:

These people, divided into different tribes, have no government nor chief; yet each is surrounded by other hostile tribes, speaking different dialects, and separated from each other only by a deserted border or neutral territory; the cause of their warfare appears to be the means of subsistence. The habitable land is reduced to the stones on the beach; in search of food they are compelled unceasingly to wander from spot to spot, and so steep is the coast, that they can only move about in their wretched canoes. They cannot know the feeling of having a home, and still less that of domestic affection, for the husband is to the wife a brutal master to a laborious slave.

Their skill in some respects may be compared to the instinct of animals, for it is not improved by experience; the canoe, their most ingenious work, poor as it is, has remained the same, as we know from Drake, for the last two hundred and fifty years.

The Fuegian wigwam resembles, in shape and dimensions, a haycock. It consists merely of a few broken branches stuck in the ground, and very imperfectly thatched on one side with a few tufts of grass and rushes. The whole cannot be the work of an hour, and it is only used for a few days. On the west coast the wigwams are better, for they are covered with sealskins. On the east coast the native's only garment consists of a mantle made of guanaco skin, with the wool outside, which they wear just thrown over their shoulders, leaving their persons as often exposed as covered. Their skin is of a dirty coppery-red color. On the west coast they wear sealskins. Among the central tribes, the men generally have an otter-skin, or some small scrap about as large as a pocket handkerchief, which is barely sufficient to cover their backs as low down as their loins. It is laced across the breast by strings, and according as the wind blows, it is shifted from side to side.

At night, five or six human beings, naked and scarcely protected from the wind and rain of this tempestuous climate, sleep on the wet ground coiled up like animals. Whenever it is low water, winter or summer, night or day, they must rise to pick shell-fish from the rocks; and the women either dive to collect sea-eggs, or sit patiently in their canoes and with a baited hair-line without any hook, jerk out little fish. If a seal is killed or the floating carcass of a putrid whale is discovered, it is a feast; and such miserable food is assisted by a few tasteless berries and fungi. When pressed in winter by hunger, they kill and devour their old women before they kill their dogs, because, as they say, dogs catch otters but old women do not.

It has never been ascertained that the Fuegians have any distinct belief in a future life. They sometimes bury their dead in caves, and sometimes in the mountain forests; but it is not known what, if any, ceremonies they perform.

While beholding these savages, one asks whence have they come? What could have tempted, or what change compelled a tribe of men to leave the fine regions of the north to travel down the Cordillera or back-bone of America, to invent and build canoes, which are not used by the tribes of Chili, Peru, and Brazil, and then to enter on one of the most inhospitable countries within the limits of the globe? Although such reflections must at first seize on the mind, yet we must feel that they are partly erroneous. There is no reason to believe that the Fuegians decrease in number, therefore we must suppose that they enjoy a sufficient share of happiness to render life worth living.

The perfect equality among the individuals composing the Fuegian tribes, says Mr. Darwin, must for a long time retard their civilization. In Tierra del Fuego, until some chief shall arise with power sufficient to secure any acquired advantage, such as the domesticated animals, it seems scarcely possible that the political state of the country can be improved. At present, even a piece of cloth given to one is torn into shreds and distributed; and no one individual becomes richer than another. On the other hand it is difficult to understand how a chief can arise till there is property of some sort by which he can manifest his superiority and increase his power.

The Fuegians in Paris, eleven in number (four men, four women, and three children) were brought thither by Mr. Waalen, after depositing some three thousand dollars in the hands of the Chilian Governor of Punta-Arenas as a security for their safe return to their native land after being exhibited throughout Europe.

SOAP AND ITS MANUFACTURE FROM A CONSUMER'S POINT OF VIEW.

SOME practical study of the subject of soap by its numerous consumers, either those who use it simply for family use, or consume it for other purposes on a more extended scale, will well repay the time and attention devoted to this purpose. We propose to give some practical information on the subject, together with a few facts for the consideration of our readers, believing that it will prove of general interest.

Many people fancy that there is really but little practical difference between the various qualities of soap sold to the public, and they consequently purchase the cheapest article they can get. Nothing could be a greater mistake. This is an age of *adulteration* in almost every article offered to the public. It has been forced on by their almost insatiable demand for *cheap* things; and perhaps in the whole range of manufactured articles sold in this country, no one article has been more extensively adulterated than soap. Both manufacturers and dealers have found the adulterated article more profitable to produce and handle than a genuine soap, as they have taken care that in satisfying the demand from the public for a *cheap* soap, at the same time to secure an extra profit for themselves by cheapening it further than was necessary! The result of this is that all kinds of substances are put in wholesale into soap simply to effect this object. China clay, silex, starch, rosin, silicate of soda (this latter a mixture of sand and soda, forming a kind of soluble glass, which hardens the soap and yet allows of an enormous amount of water being added), are all largely used for the adulteration of soap.

Now a pure soap is simply and solely a combination of tallow, grease, and oil, with either pure caustic soda or caustic potash, with a proper proportion of water necessary to effect saponification. In the case of a pure soap, it should contain about sixty per cent. of tallow or oil, ten per cent. of pure caustic soda, and thirty per cent. of water. It is an undoubted fact, however, that with all the soaps sold in this country to the public, not a single one of them fulfills these conditions. They are all, without exception, more or less adulterated.

Consumers are not generally aware that the most expensive article to the soap boilers is the oil, grease, or tallow used in the production of his soap. This is, however, four-fifths of the cost of every *pure* soap, the caustic soda only amounting to one-fifth of its value. The whole aim of the soap boiler, who makes a soap to *sell*, is to cut down the tallow in the soap, either by the substitution of water combined with starch, silicate of soda, or sal soda, which are, so to speak, the carriers of water in the soap, or such cheap articles as rosin, china clay, and silex, which simply make weight, are added. It must be confessed that the process of using and at the same time hiding these adulterants from the eye of the general consumer, has been carried to great perfection, and it is only to be regretted that the skill and ingenuity that has been developed in this line has not been employed in a worthier cause. Very few soaps that are sold contain forty per cent. of tallow or oil; twenty per cent. of tallow really is a fair average, as many soaps do not even contain this, that is to say, on an average they contain full sixty per cent. of adulteration.

Now the effect of these impurities causes either one or all of these three things. *First:* Double or treble the quantity of soap as compared with a pure soap, has to be used. *Secondly:* The articles washed with these impure soaps are injured, either by the injurious action of these impurities, or by the extra rubbing or working in the washing machine, necessarily requisite to make the impure soap do its work. *Thirdly*, and to many poor women the most important item, the washing day, is dreaded, as the various impurities act terribly on the skin, and the result is either bleeding hands, or, at any rate, an injured skin.

There is another point that shall just be touched upon as little as possible, as the subject is very unpleasant. In some of the British newspapers, published not long ago in London, there was quite a discussion as to the origin of various skin diseases and blood poisoning. Some of the most eminent London surgeons, who have made the subject of skin diseases their special study, did not hesitate to affirm

that their origin was often owing to the highly impure and often putrid fat or grease used by the soap boilers and obtained from slaughter houses; or the melting down of dead diseased animals for the grease they contain, and which were really utterly unfit for any other purpose than a manure. It certainly is maintained by many chemists that all germs of disease in these impure and putrid greases are destroyed by the strong alkali used by the soap boiler, and we hope that this is the case. The unsavory and often putrid smell, however, always hovering round the neighborhood of a soap boiler's factory, is by no means a pleasant idea to reflect upon, after reading the discussion on the origin of skin diseases and blood poisoning above mentioned! The recent study also of germs of disease, by several eminent French chemists, and their wonderful vitality in certain cases, after being subjected to all kinds of powerful acids and alkalies, renders the question of the destruction in the soap boiling very doubtful.

Our readers will say, however, why go into all these matters unless you have some remedy to propose? This is exactly what we now wish to do.

There is an old prejudice in the minds of most people in favor of home made articles, and that many things which are now purchased, instead of being made at home, as in the days of our forefathers, are inferior to what they used to be, and that notwithstanding the enormous advance made in every science and all mechanics; as good an instance of this as anything is the old homespun linens or woolens, that formerly used to last generations of wear, while the modern article will hardly stand as many years as the homespun would generations. The answer to all this is very simple—a home-made article is produced for *use*, not for *sale*, therefore unadulterated, and this is just the difference.

Now, what we would propose is that consumers, large and small, should make their own soap. In olden days our ancestors used to go through a tedious process of making soap by long boiling with wood ashes specially prepared for the purpose. The soap was excellent when it was made, but in these modern days, when both time and labor must be economized, such a procedure is impracticable.

The art of making a pure soap-making alkali has, however, quite recently been brought to great perfection. It is now possible to procure a pure powdered 98 per cent. caustic soda or pure caustic potash, put up in almost any sized package, even down to a can containing only three-quarters of a pound of powdered 98 per cent. caustic soda, which we see has actually been done by a firm of lye packers, the George T. Lewis and Menzies Co., of Philadelphia. With these articles a perfect soap can be made in large or small quantities by simply mixing them with melted tallow and a little water, forming a soap in a few minutes, and dispensing with all boiling or special apparatus. The soap so produced is highly emollient, owing to its containing all the glycerine in the oil or tallow used for its production, all which valuable article is all lost in a boiled soap. The tallow and caustic alkali are also so perfectly combined that the soap will not hurt the most delicate skin or destroy colors.

In our next we propose to continue this subject, and give the most suitable proportions of tallow or oil, pure caustic potash or powdered 98 per cent. caustic soda, and water for producing the various classes of soap most suitable for the different purposes for which they are required. We will also consider the various classes of soap, such as toilet soap, laundry soap, and special soap for washing flannels without shrinkage. Some explanation as to the beneficial effects of the glycerine contained in all soaps made by this simple mixing process will also doubtless be of interest.

(To be continued.)

THE ESSENTIAL OIL OF GINGER.*

By JOHN C. THRESH, B.Sc., Pharmaceutical Chemist.

THIS was an investigation undertaken by the author, assisted by a grant from the Conference. Mr. Thresh prefaced his paper by apologizing for the comparatively slight pharmaceutical interest which he had been able to introduce into his report.

Messrs. Wright, Layman, and Umney had prepared for him an ethereal extract from 1 cwt. of Jamaica ginger.

Distillation of this proved most tedious and unsatisfactory, yielding only about 12 fluid oz. of oil. His previous researches had led him to expect about 1·4 per cent. of volatile oil, and Hanbury and Flückiger state that Messrs. Schimmel, of Leipsic, obtain 2·2 per cent.

The product was too small for complete investigation, and therefore about a pint of the oil was obtained from Leipsic. The latter was of rather higher sp. gr., and differed in some other respects, which were pointed out.

Crude ginger oil is of pale straw color, with somewhat camphoraceous odor. The "foreign" oil was much more fragrant than the "English," but with both, when dissolved in a large proportion of dilute alcohol, the sweet, fragrant odor of Jamaica ginger was most pronounced. Taste aromatic, but not pungent. Consistency not near so limpid as essential oil usually, more nearly that of almond oil. Sparingly soluble in rectified spirit, but soluble in all proportions in ether, chloroform, benzol, carbon disulphide, and glacial acetic acid. The fresh oil forms with glacial acetic acid and rectified spirit clear solutions; but oil which has been kept for some time, when shaken with excess of either of these solvents, forms an opalescent mixture.

The author of the report detailed at considerable length the results of fractional distillation of both oils. His examination showed that essential oil of ginger is an exceedingly complex mixture of hydrocarbons and of their oxidation products.

The more volatile portion contains the odorous principle (most probably an oxygenated compound), and is most susceptible of oxidation. The soft, resinous, fragrant matter which gradually forms on the lid of a jar containing ground ginger is, doubtless, produced by oxidation of the oil, which, slowly volatilizing at ordinary temperature, condenses on the lid.

Both the oils examined consist chiefly of a hydrocarbon, probably with formula $C_{15}H_{24}$, but the hydrocarbon of the "English" oil is isomeric with that of the "Foreign" oil, the former boiling at a higher temperature, and differing remarkably from the latter in its action on a ray of polarized light. Their compounds with hydrochloric acid appear to correspond.

Cymene is a constituent of the distilled oil, and most probably of the crude oils, unless, as has been suggested by Wright, some constituent of formula $C_{10}N_{14}O$ has by the action of the heat been decomposed, yielding water and cymene.

The portions boiling below 161° consist chiefly of a terpene, which probably, if further purified, would have been found to correspond with those of Tilden's first group.

The crude oil also contains a little formic and acetic acids.

Notable quantities of aldehydes and ethereal salts are absent.

A dilute alcoholic solution of the ginger oil is a remarkably good flavoring agent, capable of imparting to a very considerable proportion of aqueous fluid the very pleasant aroma of Jamaica ginger.

The President, referring to a remark of Mr. Thresh's, that he had received a great many letters asking him further about the soluble essence of ginger, said that probably as so many others were interested in the subject, they should hear of further experiments in that direction from some present.

Professor Attfield said the Conference was to be congratulated on Mr. Thresh's admirable reports on the chemistry of ginger, which illustrated the value of the system of grants for aid in pharmaceutical research, which they were prepared to vote. He urged any one who was willing to undertake an investigation of this sort not to hesitate to apply for a grant to pay for materials, as they had funds in hand for the purpose. He would like to ask whether Mr. Thresh had satisfied himself as to the unquestionable genuineness of the foreign oil. He knew that manufacturers generally felt honored in being asked to supply materials for a scientific investigation, and he had no reason to suppose that in this case the oil supplied had been other than perfectly genuine, but as considerable difference had been found in the samples, it would be interesting to know whether the purity had been tested.

Mr. Thresh said he had every reason to believe that the oil was quite unadulterated. He had proved that it contained no alcohol and no turpentine. It was sold at about 50s. or 60s. per lb.

Mr. Groves said that he had found nothing better for a soluble essence than an essence made with weaker spirit. The highly concentrated essences lost some of the fine flavor of ginger. He found he got a better flavor by using spirit in the proportion of 5½ rectified spirit and 2½ water. It would mix with water, though not making a perfectly bright solution. It was, however, liked very much for making ginger beer in some works with which he was connected.

Mr. Thresh recommended as a simple process of making an essence which would mix fairly with water, to prepare it first with rectified spirit, then add to the percolate about half its weight of water, shake with silica, and afterwards to restore fully the aroma add a drop or two of the essential oil of ginger. In reply to a question from Mr. Shenstone as to the economy of thus getting the flavor, Mr. Thresh said the imported oil cost about 8s. per oz., but a very little went a long way. He had not succeeded in extracting the aromatic principle of the ginger.

* Read before the British Pharmaceutical Conference.

A NATURAL WOOD PRESERVATIVE.

APPARENTLY, we are just becoming aware of the fact that certain of our valuable timbers are just about exhausted, notably the case with pine and walnut.

As the happy go-lucky improvident trusts to the plenitude of his meal barrel until, at once, he is reminded of the nearness of actual want by his dipper striking the bottom, so we, trusting to Providence to always keep up the supply, have gone on ruthlessly, *recklessly* using and even wasting annually enormous quantities of timber. No thoughts have been entertained of a future scarcity until a halt is called by some conservator of our lumber interest, an inventory of our resources is taken, and the result—that we are on the verge of a timber famine—is made known.

The demands for timber are manifold and ever increasing.

In the matter of railroad ties alone the total result is startling.

The agricultural report for 1869 estimated that at *that* time the railroads of the United States alone required, annually, for ties, the timber from 1,500 acres.

A recent writer states that, at the *present* rate of denudation even, the pine forests of Michigan will not last more than seven years.

What is to be done?

Straw and paper lumber are already offered as substitutes for pine, but straw and paper, useful as they undoubtedly are, as lumber, cannot supply *all* the demands made on a pine forest.

Obviously, two courses are open to us: the reproduction of the pineries by cultivation, and the conservation of manufactured timber.

By taking the latter course it is within the bounds of possibility that the present supply can be made to equal the demand for years to come.

The difficulties in the way of cultivating successfully the white pine are next to insurmountable. It is a fact well known among lumbermen that it will not reproduce itself on the parent soil.

In Northern Wisconsin are immense tracts of country, once covered with a dense growth of pine timber; now they are barrens, producing nothing but blackberries and a variety of beach plum. Young timber, such as would follow immediately after the removal of a parent forest of oak, will not succeed a pine forest.

Observation and experiment have shown that the white pine thrives best on a sandy soil, in a cool climate, and at a comparatively high altitude.

Certain of the high plateau regions of the Rocky Mountains offer these three features.

Possibly, experiment may yet show how the ordinary difficulties of reproduction can be overcome by cultivation in these localities.

But the objects of this article are to call attention more especially to the second remedial agency—the preservation of manufactured timber from decay.

The conservation of wood is not a new suggestion.

Since the time of Glauber, the eminent Dutch chemist, *many* plans have been proposed for the artificial preservation of wood.

The great majority of these are totally valueless, all are more or less expensive.

The desideratum is for a cheap, and, at the same time, effective antiseptic agent.

In securing this we may do well by being guided by the hints of nature.

In the summer of 1880 there was sent to my laboratory a package of dry, ashen-gray soil, with a request that it would be examined and a report rendered as to its constituents. Careful analyses showed its peculiarity to consist in its extraordinary richness in alkaline chlorides.

More especially was this true in regard to sodium chloride.

The sender, a prominent official of the Union Pacific Railroad, explained that in Southwest Wyoming a large portion of their territory was covered with this soil and that it was thought that it had the property of preserving the ties laid in it. Ordinarily their white pine ties had to be replaced in from three to four years, but it was observed that where ties of the same wood had been laid in this soil they resisted decay much better.

Indeed, many of the original timbers, laid twelve years ago, are in place, in perfect condition, to-day. I examined, also, specimens of the wood which had resisted decay so remarkably.

Its specific gravity was a trifle higher than the average; the texture was very firm. It gave a larger proportion of ash than the ordinary white pine, according to analyses of Dr. Wolff.

The ash analysis showed that the excess was probably due to increased amounts of chlorides of the alkalies, as they existed here in excess as well as in the soil.

A series of experiments, carried on by myself, to determine the relative durability of this preserved wood and ordinary white pine, under conditions differing from those where this timber had acquired its property of resisting decay, *i. e.*, a lower altitude, a moist and warm climate, resulted in showing that this wood *retained* its power to resist decay even under these new conditions.

During the past summer I paid a personal visit to the region in question, and found, what I had already surmised to be the case, that it was the bed of one of the salt lakes or seas of the tertiary age.

It occupies a long, narrow valley—the Bitter Creek Valley—extending from Bitter Creek station, on the Union Pacific railroad, to Green River.

The railroad passes through the valley, and the extensive coal mines of the Union Pacific Company are located in it. The climate at this altitude is very dry, probably not over from five to ten inches of rain falls during the year.

The rain storms, though, are very *intense*, being often what are known as "cloud-bursts."

In the spring portions of the country are sometimes flooded for a brief period by melted snow from the adjacent mountains.

During the long and severe droughts, the soil becomes like ashes and wood is most thoroughly desiccated.

The succeeding rains dissolve the soluble salts present in excess in the soil. It is then greedily absorbed by the wood.

During the next drought, as the water is evaporated from the wood, the salts are left behind in the cells and pores.

In this way the sap—always the agent and promoter of decay in wood—is washed out and replaced by the non-fermentable constituents of the soil, or it is so chemically altered by these salts as to become inert and inoperative as a factor of decay.

Taking these facts into consideration, it seems that nature has here given us a clew to the thing desired—a cheap and effective wood preservative—useful, at least, where rough timber is to be used and where it is to be placed in contact with the earth.

H. H. NICHOLSON.

Laboratory of State Normal School,
Peru, Nebr., Oct. 20, 1881.

OZONE THE CAUSE OF PHOSPHORESCENCE.

AN interesting note, translated from the *Bulletin de la Société Chemique de Paris*, is given in the August number of the *American Journal of Science*.

The cause of the luminosity of phosphorus is said to be due to ozone, a theory which is not included in ordinary text-books, although Joubert and others have called attention to the subject. Chappuis has extended his researches relative to this matter, and has studied the effect of ozone upon the luminosity of phosphorus in the presence of oxygen. Fourcroy had long ago observed that in pure oxygen, at a temperature of 15° C. and under atmospheric pressure, phosphorus was not luminous in the dark. Chappuis finds that the introduction of a bubble of ozone produces the phosphorescence, though but momentarily, the ozone being destroyed. It is not the vaporization of the phosphorus, but the combustion of its vapor which determines the phosphorescence; the entire space occupied by the oxygen at first appearing luminous, the solid phosphorus becoming so only after all the vapor has been burned by the ozone.

A very striking experiment was made by inverting two cylinders, one containing air, and the other pure oxygen, over two dishes containing potassium iodide and starch solution. A fragment of phosphorus was plunged into each gas in contact with the liquid. In the first, the phosphorus became luminous, and the solution became blue. In the second, neither phenomenon appeared. Whenever the phosphorescence was visible, ozone was present; and whenever ozone was absent there was no luminosity.

Bodies which destroy ozone or are destroyed by it also destroy this luminosity. Oil of turpentine does so effectually. Ozone, on the contrary, directly influences its production. Chappuis considers, therefore, that the luminosity of phosphorus in oxygen is one of the most delicate reactions for the detection of the presence of ozone; and he proposes to further investigate these phenomena.

PARAFFIN TO PRESERVE EGGS.

ENDLESS expedients have been resorted to so that eggs may retain their freshness; unfortunately, in many cases, the methods adopted, while they prevent decay, injure the taste. Paraffin, as a thin coating, has been recommended by a French authority as preferable to all others; and while the oil of commerce has a well-known smell, the solid paraffin, resembling white wax, has no perceptible odor.

One kilogramme of material is said to be sufficient to coat, and effectually to preserve, 3,000 eggs. Samples thus treated in July were still heavy and untainted in November and December. When not so treated, eggs lose weight, and obviously become unsalable when kept without any precaution being observed. It is asserted that eggs subjected to the paraffin treatment presented no trace of alteration after a lapse of two years.

PRESENT CHEMICAL DOCTRINES: GENERAL THEORY OF CHEMICAL ACTION.—All chemical reactions may be regarded as actions either of contact or of mixture, and are regulated in the former case by specific gravity and molecular weight; in a word, by the molecular volume of the bodies present, and in the second case, by their molecular weight. He rejects the notions of molecule and atom, and employs the terms equivalent and atomic volume. —*E. J. Maumené, in Les Mondes.*

THE PHILOSOPHY OF INSANITY.

By DR. JOHN SANDERSON CHRISTISON, New York City Asylums for the Insane, Blackwell's Island and Ward's Island.

PRECISELY what the normal metamorphosis of brain tissue is remains a problem; and no better is our knowledge of the nice process by which that organ is adequately re-enforced

Aside from its requisite *pabulum*, the integrity of a vitalized germ is dependent upon more than chemical, mechanical, and electrical properties. Is it that the differentiation of conglomerate homogeneous cells is simply a rearrangement of properties—a question of subtraction and addition—produced by extrinsic agencies acting upon the inherent properties of the cell substance? or, rather, is it the effect of a metaphysical entity, as much a part of a complete germ as any physical constituent, and accounting for its behavior as differing from the product of the mere contiguity of its atomic components? Man as a complexly differentiated cell of great growth must necessarily be viewed from one of these standpoints. But they are questions of only speculative interest.

In a living cell there are *force* and *matter*, and I ask for the proof that the whole of this force is the mere product of elaboration by or from the cell molecules. Does it not seem easier to believe that more or less of the cell force (*i. e.*, a particular element of it) is *imparted* to the cell from the source of its like (the force in question), differentiating and developing it (the cell) according to its stamp, and modified or restrained in result only by the effects of its environment? In the earliest embryonic stages of evolution this cell force is engaged only in the process of differentiation, gradually withdrawing itself (perhaps also being gradually modified) to a special part or center of its domain, and as its intimacy with *inside* conditions diminishes (the necessity diminishing), its intimacy with *outside* conditions increases *pari passu*, until ultimately it would seem as if the *force* and the *matter* were distinct entities. The cell *force* has now become *mind*, with the brain as its immediate center, and which, so to speak, is so nicely cut for its service that an effect on the one implies an effect on the other. It is simply the nice relationship of *body* with *mind* that admits of any one doubting their existence as distinct entities. The one needs the other for its *form*, the other the one for its *manifestation*.

In mental aberration (excluding idiocy, imbecility, and eccentricity) there is always an abnormal state of the brain, and which abnormality when removed admits a return of the usual mental character. This is the accepted theory, and it only goes to show that the mental machinery (the brain) is wasted, lacks oil, or has a screw loose in any given case of insanity; the mental faculties are fettered, and which fettering is at once a consequence and a cause. The causes, proximate and ultimate, of brain disorder, act either by way of the mind or by way of the body, usually both. They are inherited, remote or predisposing; acquired, immediate or exciting. We will first glance at heredity.

Though a particular class of cells have the same fundamental stamp or character, they will have, so to speak, a *circumstantial mark* which will cause them to differ from a normal criterion. By this circumstantial mark I mean the parental impression of morbid condition in the embryonic cell, causing defective progeny. It may be so grave and meet with such favor to its growth as to overwhelm the whole vitality at a very early age; or so slight as never to be noticed. These inherited taints are usually the products of parental vices; and such being the case, the progeny usually lack that watchful and exemplary discipline conducive to better health. As a rule their nursing but fosters their inherited weakness, to which they sooner or later succumb. It is often the case that different offspring of the same unhealthy parentage die from very different *chronic* affections; and, as it is to be presumed the morbid inheritance is the same in each of the offspring, their different disease developments must necessarily be due to their individual peculiarities of habit and surroundings. Call the hereditary defect a retrogressive resultant of the bad habits of antecedents, bad habits continued can only cultivate the fault. But as all nature tends toward perfection, the disposition, during evolution and growth, will be to a removal of this circumstantial mark. This removal in speed will be proportional to sanitary circumstances, and *inversely*, proportional to the impress of the mark.

In insanity the immediate material causes are, viz.: (1) fault of blood *quality;* (2) fault of blood *quantity;* (3) fault of blood *current*. If any one or more be present there is necessarily a nutritive departure from the normal, and, owing to the mutual dependence of one organ upon another, the whole system suffers, the brain included. This implies a functional impairment in the secreting and excreting glands persisting with the cause, and causing aggravation of affairs to persist. Placed under the same conditions as the others, the brain is the last organ to give way, as must be inferred from the fact that it proportionately loses by far the least in general waste or starvation. Thus a giving way of the brain when affection of the other organs is but slight, must have, in addition to the general or constitutional cause, some special factor or factors for its production. These must be either *mental* or *local-material*. The local-material (traumatic) are so comparatively seldom met with that I shall here leave them unconsidered. We will now glance at the mental causation of insanity.

The mind in its simplest cognizable form would seem to be but little more than a piece of metaphysical protoplasm—a conglomeration of simple ideas. Slowly these ideas associate and blend—evolve to faculties—and a kingdom is formed. For functional value, the mental faculties are mutually dependent, and any inordinate action of the one must necessarily be at the expense of the rest. However, for all practical purposes, in the consideration of insanity we must look upon the mind as a unit, for it is always affected in its totality. It is depressed or exalted in action; narrowed or fickle in comprehension. From its nice relationship with the brain it necessarily follows that a changed condition of the one implies a changed condition of the other. Mental disturbance in any degree necessitates a brain disturbance in some degree, and, according to the amount of its repetition or persistence, there must eventuate a corresponding diminution of resistance to that particular form of disturbance: this according to the law of habit. Thus an act by repetition tends to become automatic, and for its performance ultimately loses the necessity of volitional effort. But this law does not apply to acts that are at no time proper. There is a test *how, when*, and where for everything, and whatever is not thus must be so much obstacle toward perfection.

In perfect health the brain maintains its normal by a sufficiency in amount and variation of mental exercise, and the other organs by a fulfillment of their requirements for and of one another. Without a correspondingly increased exercise of all the other organs, an increased exercise of any one implies an enfeeblement of the rest by demanding their increased attention to its increased wants, and leaving them uncompensated. Such a condition degrades the entirety of the system and results in an inefficiency of all the parts. Therefore mental exercise which in itself is healthy but in amount excess, is at the expense of the general welfare of the system, and as the well-being of the rest of the system is necessary to the well-being of the brain, it acts as a cause of inadequate brain repair.

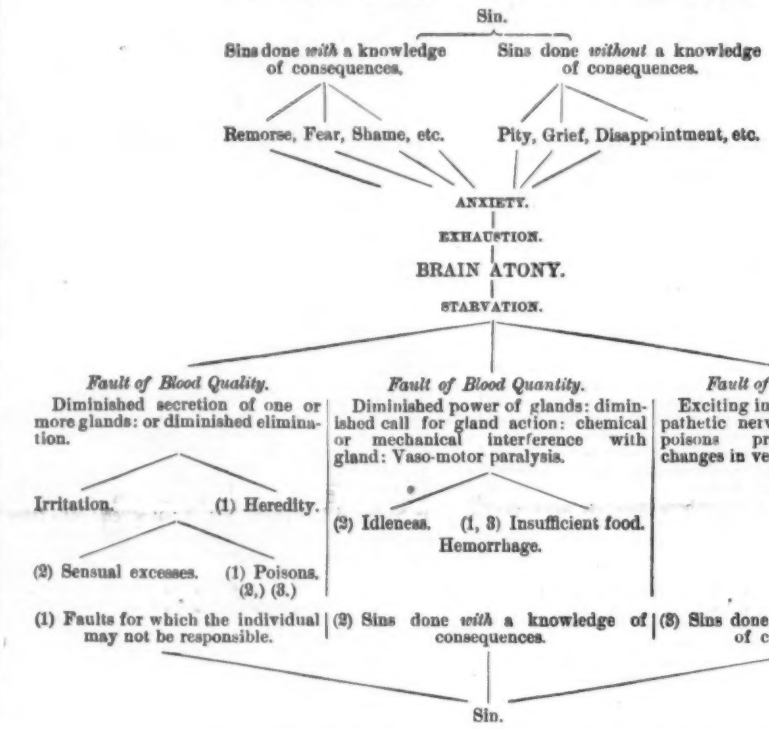
Any unhealthy condition of mind of purely mental origin, I shall call anxiety. Its various forms are *remorse, fear, grief, pity*, etc., all of the same fundamental nature, differing only in degree, and ultimately producing the same result, viz.: *brain atony*. Their causes I need not dwell upon, they are so varied and yet so well known. I consider anxiety to act upon the brain as an irritant, in the scientific sense of that term, and ultimately exhausting energy. If the individual is in good health and under the prime of life, he will be able to hold his own with a certain amount of anxiety, for his recuperative powers are still greater than the ordinary destructive. But if he does not have good health, and his recuperative powers are simply able to cope with the ordinary waste, he must necessarily lose, lag, or step back in the race, perhaps never to completely regain. If anxiety continues, he must break down, to manifest brain disease sooner or later, should some inter-current affection not cut him off.

The difference between the mental and physical processes producing brain atony, is that the mental is *active* and the physical is *passive*. There is a disproportion between the *supply* and *demand* of brain energy—tone or strength.

CAUSES OPERATING FROM THE MENTAL SIDE PRODUCING BRAIN ATONY.

(*In order from above downwards*).

Def.—Any condition against our best welfare or ultimate object.


Sin.
Sins done *with* a knowledge of consequences.
Sins done *without* a knowledge of consequences.
Remorse, Fear, Shame, etc.
Pity, Grief, Disappointment, etc.
ANXIETY.
EXHAUSTION.
BRAIN ATONY.
STARVATION.
Fault of Blood Quality.
Diminished secretion of one or more glands: or diminished elimination.
Irritation.
(1) Heredity.
(2) Sensual excesses.
(1) Poisons. (2,) (3.)
Fault of Blood Quantity.
Diminished power of glands: diminished call for gland action: chemical or mechanical interference with gland: Vaso-motor paralysis.
(2) Idleness.
(1, 3) Insufficient food.
Hemorrhage.
Fault of Blood Current.
Exciting impressions on the sympathetic nerve system: action of poisons producing structural changes in vessels.
(1, 2, 3.)
(1) Faults for which the individual may not be responsible.
(2) Sins done *with* a knowledge of consequences.
(3) Sins done *without* a knowledge of consequences.
Sin.

CAUSES OPERATING FROM THE PHYSICAL SIDE PRODUCING BRAIN ATONY.

(*In order from below upwards.*)

Just what a perfect mind is, lies with a decision of its economy in nature—the grand object of its existence. On this question let us glance for a moment, and see how we may arrive at a criterion. Now, in the habitable world one place is pretty much the same as another, the difference being mainly in degree. Plants, animals, hills, waters, sun, moon, stars, etc., are everywhere to be found, and the same laws of nature everywhere prevail, all pointing to the same grand design, the same cause and the same end, so that as the human mind must have the same faculties in all places—common experience must be essentially the same. If the resultant of common experience be *common sense*, a right use of *common sense* by different beings, even very far apart, must lead to the same decision on any question of common interest. Of course the amount of evidence necessary to the different individuals will differ with their degrees of knowledge. The ignorant will have simple but satisfying argument; the learned may have abstruse though often not more satisfying. Thus we can have no ample apology for not having an approximately true criterion from which to deduce rules of conduct for our best welfare. There must be a positive right and a positive wrong universally the same. When we arrive at the age of reason we became more or less responsible for the perpetuation of those bad habits of our early education, the result of the example or neglect of our wardens. The good habits may be said to be those which work in harmony with the rest of nature for its grand object; the bad ones, those that do not so tend. A habit has its force in proportion to its persistence, and its *reverse* necessitates a proportional effort.

The precise nature of our *ideation* will depend upon (1) the *nature* of our ideas, (2) their *number*, (3) the *order* in which they are associated, and as no two individuals are precisely alike in those particulars, the same object for scrutiny will present somewhat different aspects to the different observers. This is the reason for the difference of opinion on the same subject by perfectly rational persons, but who, unlike the insane, will have their different opinions reduced to a common one by a competent interchange of ideas. Those ideas which are necessary to our best welfare are insured us by the sameness of our general experience and mode of its evolution. It is fortunate we can *think* or we would be mere puppets, and live without any chance of harmony with one another or nature in general.

A common and leading symptom of brain disease is a delusion, held notwithstanding the presence of ample proof to the contrary. It is the product of defective ideation. The attention is given more to the *pro* side than the *con* side of the object of delusion. Attention is the first condition needed to the appreciation of an object, and if it equals the measure of scrutiny, and the measure of scrutiny equals the number of ideas engaged and the order in which we bring them to bear upon the object, together with the manner in which the object is exhibited, then the impression or notion received of the object will accord with the measure of attention given it. Here we have the explanation why our second thoughts upon the same question are often more correct than our first. A well-balanced or healthy mind may have its attention directed either by voluntary effort or by external circumstances, but will in either case possess inherent power to withdraw its attention at any time. On the contrary, a so-called "weak mind" will be, in proportion to its weakness, the subject of external circumstances with regard to the object of its attention. I can understand high education to be consistent with a particular "weakness" of mind, provided the tendency of that education has had a bias. The question of *mesmerism* and its allies (as forms of the product of *expectant attention*) but shows how completely the mind can be concentrated on a particular idea by the force of particular circumstances, internal and external.

The longer we dwell on an idea the longer are we likely to dwell upon it, if the favoring circumstances remain undiminished. If we repeatedly dwell upon an idea which we at first know is purely imaginary, we will, according to our bias, gradually lose sight of the points that go to prove its exact nature. If the idea is consistent with natural law we can suffer nothing; but should it not be so, its tendency will be to dominate against our best welfare, and perhaps completely alienate us from the right. Many of the delusions of the insane are but transient, being at once withdrawn by suitably put evidence. They are the mere expressions of fleeting imaginations. However, as repetition favors repetition, so the oftener they are called out they will recur with the greater ease, and the more constant they will be present. When a delusion dominates more or less constantly, it would seem to be the result of fallacious reasoning or erroneous data, or both, and the *taking cognizance of nothing but evidence of support*.

The other leading symptom of brain disease is an incoherence of ideas or their disconnected association. The explanation of this condition of affairs I take to be thus, viz., Thinking is an effort, and implies the use of a proportionate amount of brain energy; but as the brain capacity for holding energy is already diminished, and the new capacity amount is perhaps also diminished, therefore the effort of thinking or holding our attention on a subject, and recalling and comparing the wanted data to the formation of a conclusion, may necessitate much more energy than the brain can comfortably spare; and so, may be, we lose our question after a step or two has been taken toward its solution.

Post-mortem examination has found tumors and disease relics in almost any part of the brain without any observable *ante-mortem* expression. Comparatively few insane die with any other *post-mortem* appearance but waste or softening. But the appearances of waste and softening are often found in the brains of persons who never betrayed any insanity. The knife and the microscope, with the most experienced eye, cannot always show us positive abnormality, even in unmistakable cases of insanity.

Therefore, for the explanation of any particular form of brain disease manifestation, we must look somewhere in the line of its production. As to the condition of the body in general, there is usually nothing peculiar to insanity; yet, usually, there is some noticeable fault. When muscular paralysis, or incoördination, is well marked, we may expect to find that sensual irregularities and excesses have predominated in the causation. Except in *traumatic* cases, the duration of the malady may be fairly measured by the sum of its predisposing causes

Just as there are many and different numbers of causes in many proportions, so must there be many results. There

are no two cases of insanity exactly alike, though many have much similarity in symptoms, course, and duration, perhaps bearing a proportion to the differences or likenesses of character in every-day society.

Remedy for brain atony must necessarily be by way of the mind and by way of the body—the avenues of cause. Special and general medication and hygiene are what we now provide in our public asylums for the cure of insanity. But what remedial measures do we bring to bear on the mental side? Almost none.

BORATE OF QUINOIDINE.

PROBABLY there is no foreign chemist with whose personal appearance English pharmacists are more familiar than with that of Dr. de Vrij, of the Hague. He has been called the Flying Dutchman on account of his frequent visits to our shores. Cosmopolitan in his friendships and in his speech, he is to be met with wherever a congress or a scientific gathering forms a reasonable excuse for travel. At the late International meeting at London he was silent more than is his wont, though he pleaded for "his own little country, Holland," in the matter of representation on the Pharmacopœia Commission.

The doctor adds to his other merits that of being an authority upon cinchona, its cultivation, and its preparations. He has just brought forward a new febrifuge, to which he has given the name of borate of quinoidine. Shortly after the discovery of quinine by Pelletier and Caventou, a German chemist, Sertürner, to whom we are indebted for morphia, found in yellow bark an amorphous alkaloid, called by him chinoidin, with the further designation of "killer of fevers." Since the introduction of the industrial cultivation of cinchona numerous analyses have confirmed the fact of the existence of this amorphous alkaloid. In 1872, while analyzing a certain red cinchona sent by the Duke of Argyll as Secretary of State for India, Doctor de Vrij found not less than thirty parts of this amorphous alkaloid in one hundred parts of the mixed alkaloids obtained. He considered then, as he has since done consistently, that an alkaloid of such known great febrifuge power should not be lost to therapeutics.

As the combinations of this alkaloid with acids are equally amorphous, and very soluble in water, it is found in the mother liquor of the sulphate of quinine works, and may be precipitated from it by an alkali in the form of a resinoid matter, of dark color, called crude commercial quinoidine. Unfortunately a mass of impurities makes up the greater part, so that it cannot be used therapeutically in this state.

More or less purified, this quinoidine has been employed as a febrifuge in various countries; but in France it is only since 1878 that attention has been directed to it by a memoir read before the Academy, May 21, 1878, by Dr. Burdel. The quinoidine has been purified by M. Duriez by a process not divulged.

After many years' endeavor to introduce quinoidine in a suitable form into medicine, Doctor de Vrij considers that he has at length attained his object by combining the amorphous alkaloid contained in crude quinoidine with boric acid. The method followed has already been published in Dutch, and will soon be translated into French; meanwhile the remedy is prepared in an unexceptionable manner by the firm of Darrasse & Co., Paris.

Borate of quinoidine is an amorphous powder, more or less yellow, and very slightly hygroscopic. It is soluble in three parts of cold water, and the solution is decidedly alkaline. Its solubility and alkaline reaction give it a superiority over the sulphate of quinine in hypodermic injections; 100 parts of borate contain at least 54 parts of pure quinoidine. The right-hand molecular rotation varies from 10° to 20°, being a means of ascertaining the genuineness of the preparation.

Considering the received opinion as to the cause of marsh fever, and the antiseptic properties of boric acid, this combination of boric acid with the amorphous alkaloid of the cinchonas may reasonably be expected to prove useful, particularly in those countries where fevers are endemic, and where the high price of sulphate of quinine is often an obstacle to its use. Whereas the sulphate costs at the present moment 500 francs the kilo, the new febrifuge will not exceed 40 francs. Dr. Hermanides has tried the remedy in Holland, and gives a favorable report.—*Chemist and Druggist.*

THE DISPOSAL OF HOUSE DRAINAGE.

By E. S. PHILBRICK.

ALTHOUGH much has been written and said upon this subject of late, its great importance, arising from its intimate connection with the health of our families, may justify a further consideration of the general principles which should be observed in its treatment, as determined by the light of modern experience.

Much improvement is observed in the practice of the best plumbers in our large cities within a few years. The public has learned to demand certain things as essential, and local boards of health, wherever such work has come within their control, have aided much in the diffusion of information, as well as in advising improved methods. Among such items of better practice may be named the following:

The substitution of metallic pipes, with metallic joints, for earthen pipes and cement joints for all drains inside of house-walls.

The extension of the waste-pipes through the house-roofs into the open air.

The provision of more adequate quantities of water for the flushing of water-closets, and its application by a sudden dash from tanks near at hand instead of dribbling streams from the opening of faucets or small valves attached to the supply-pipes.

There has also been more attention paid to improved forms of traps and their ventilation, although the old-fashioned D-trap and its variations are still advocated by certain plumbers who cling to deep ruts and ignore the reasons often publicly given for their condemnation.

I may add also a marked inclination to follow English examples by interrupting the flow of air from cesspools or sewers through the house-drains themselves. This is done by the construction of suitable disconnecting traps, with ample air-vents, outside of the houses. Although some difference of opinion exists as to the importance of this practice where good sewers are provided, arising from the supposed cleanness of the sewers themselves, there is no intelligent advocate of the omission of such traps wherever the drainage is collected in *cesspools*. Nevertheless, the construction of such traps in actual practice is the exception rather than the rule in most country houses, and if they are inserted at all, it is often done without sufficient provision for the ventilation of the lower end of the house-drain itself. This drain is deprived of its ordinary air-draught from below by the interposition of such traps, and if the connection with the open air at this point—directly above the trap—is not provided, the result is attended with much trouble.

But while rejoicing at the signs of improvement which I have here referred to, I can but lament at the sloth and apparent indifference with which the mass of our people regard the subject of the ultimate disposal of their house drainage or sewage, especially in suburban districts and isolated houses, where no sewers are found. This part of the question has received comparatively little attention, so that the same general practice is to be seen now, under the present conditions as to water supply and the present demand for plumbing fixtures and conveniences, which existed twenty years ago, under circumstances which were far less likely to produce harmful results than the present modes of building and living are likely to do.

The ordinary method in constructing country houses, whether the villa, intended as a home for a family with ample means, or the village residence of a small tradesman and mechanic, is generally as follows: A pit is dug in the earth, often within a stone's-throw of the house, for the lot may not be large enough to go further, and this pit is lined with a wall of loose stones or brick, without regard to tightness, into which all the house drainage is conducted. A cover is provided, of planks or stone, and this is often buried a few inches with earth, for fear of its "making a bad smell near the house." The theory of such pits is specious enough; viz., that the soil has unlimited powers of absorption, enabling such a pit to drink up and render neutral all the filth which the family discharge into it without the slightest further attention on their part. Sometimes, it must be confessed, the liquid is found to have filled the pit, and to be either oozing out upon the neighboring surface or backing up into the house through the drain; but the head of the family is by no means disconcerted by this apparent failure of his plans. He sends for a mason and constructs another pit like the first, a little below it, to take its overflow. In fact, sometimes three or four of these nests of pollution are made in a row, each one disgorging into the next, and the proprietor thinks he has an admirable arrangement, for the nastiness is all out of his sight, and generally beyond the reach of his other senses. If he knows enough, he will have provided a good running-trap just outside of his house, with an ample air-vent for the house-drain, so that the fermenting contents of this chain of retorts cannot so readily send their gases into his house.

Suppose this safeguard to be properly applied, which is rarely the fact, what is the result? Are one or more holes in the ground about a house capable of receiving, decomposing, and rendering harmless all the filth which a family throw out from their household? Experience has shown that when left to accumulate and ferment in such pits as I have described, the decomposition is very imperfect, and the accumulation of filth in the pores of the soil is constant and progressive. Any one can satisfy himself of this fact by emptying such a cesspool and digging out the surrounding material after it has been in use for a term of years. He will find the soil saturated with a black, slimy, stinking fluid, nauseous beyond description, and reaching beyond the cesspool walls to an extent limited only by the want of pores in the material which happens to lie there. If this is loose gravel or sand, the fluid penetrates it readily at first, and its traces can be found for several feet, if not several rods from its origin; but the pores gradually become filled and refuse to take more, so that if not frequently emptied, the pit must be relieved by an overflow as above described. With small families, consisting of but six persons or less, where the soil is naturally porous, and if the family uses but little water, such as they pump for their daily wants, this arrangement may continue indefinitely without *apparent* harm. But the more porous the soil, the further will the percolation extend from its center, and the larger the mass of polluted earth will become. Even in clayey soils and rocks there are often found cracks and seams which serve as channels for such percolation for an indefinite period. Its course is naturally downward, in any direction where such cracks may lead it, and is by no means controlled by the direction of the slope of the surface. Such cracks and pores serve to absorb, and to lead into and through the soil, an enormous quantity of rain-water in this climate, at least fifty per cent. of all that falls. In the neighborhood of Boston the annual fall of rain is about forty-four inches. This amounts to no less than five thousand tons per acre, so that at least twenty-five hundred tons per acre are absorbed here by the soil every year, most of which is again given up to the air by evaporation, either directly or through vegetation.

Now the class of houses I have just been considering derive their supply of drinking-water mostly from wells, which are merely holes in the ground in which the rainfall is caught or intercepted while so percolating through the soil. It is generally the same water which has fallen in the form of rain upon the surface immediately about the well; for, though underground springs or streams may sometimes bring it from a more remote point, such sources are purely fortuitous and always uncertain and obscure. It is easy to see that the more porous the soil the less trouble a cesspool will give its owner by getting filled up and needing frequent cleaning out. But such a state of things is pretty sure to poison the source of the family's water supply sooner or later, if this be drawn from a well within a few rods of the cesspool. This result will follow, even though the latter be on lower ground than the top of the well, for the water is drawn from the bottom when the well is low, and this point is almost invariably a good deal below the cesspool.

It seems needless to enlarge upon the risks incurred by mixing the house-refuse with the drinking-water. Such a condition is repulsive enough to disgust the coarsest sensibilities. But a general belief prevails in the community that their wells are supplied from some mysterious sources—"living springs," as they call them—coming from some unknown depths, and bearing but little relation to the water falling on the surface near them. The fact is that even where such springs exist, they are not the *only* sources from which such wells are supplied, and almost any person can convince himself of the fallacy of this faith by a very simple experiment, viz.: Empty a bushel of common salt into the cesspool after testing the well-water for salt in a dry time, and then test it again at intervals of a few days for a month afterward. There are but few soils in which a connection between the cesspool and the well could not be thus detected, if the distance between them were not much greater than the depth of the well.

In the report of the State Board of Health, Lunacy, and Charity of the State of Massachusetts for 1880, an instance of this sort is related, which I quote, as follows:

"If the risk is not in all cases great from the contamination of wells by vaults, etc., yet it is often unsuspected, so far as any taste, smell, or appearance of the water is concerned, and may be attended with the most serious results, a striking illustration of which is furnished by Dr. George Atwood, of Fairhaven, as having occurred in his experience.

"In the latter part of August, Mr. —— was ill with what seemed to be dysentery, but not so as to prevent his keeping about. On the 7th September he felt quite ill and sent for Dr. Atwood, who pronounced the disease typhoid fever. In the meantime his dejections had been passed freely in the privy vault, which was *one hundred feet distant* from the well (nearly twenty feet deep), and separated from it by a dry gravel and loam. After this date there were two heavy rains, presumably washing the fluid and soluble portion of the excrement from the vault, through the soil into the well by a channel already formed, or by soakage into the ground-water. The water in the well was very low at the time, and could be all pumped out in a few minutes. September 30, the wife became ill with typhoid fever. October 3, a daughter became ill with typhoid fever. October 6, another daughter became ill with typhoid fever. October 7, two sons became ill with typhoid fever. October 8, another daughter became ill with typhoid fever. October 12, another daughter became ill with typhoid fever.

"The youngest boy had the disease in a mild form, beginning about the middle of October. An examination of the well water by Professor Nichols, October 17, showed that it contained in parts per one hundred thousand:

Ammonia	0·001
Albuminoid ammonia	0·013
Total solids	20·03
Chlorine	3·3

"In order to ascertain whether there was a direct communication between the vault and well, a bushel of coarse salt was put in the vault October 24, and a bushel of fine salt October 31, and the subsequent chemical examination gave the following result:

"Amount of chlorine in parts per 100,000

DATES.	
October 26	3·9
October 29	3·9
November 2	4·0
November 5	4·4
November 8	3·5
November 13	3·4
November 17	3·4
November 20, rain	3 3
November 23, water low in well	3 1
November 26	3·1
November 30	3 0
December 3, water low	2·9

While before putting in the salt the chlorine was, as stated above, only 3·3.

"It seems clear that the effect of the salt was directly felt in the well, and that there was abundant opportunity for the dejections of a man ill with typhoid fever to pass into the water which his family were in the habit of drinking. No other cases of typhoid fever were known to have occurred in the vicinity during the summer."

It must always be remembered that water which is drawn from a well in time of drought, when the supply is low, is drawn from the pores of the surrounding soil *in any direction*. So that if we lower the level of the water in the well by continued pumping, it will be partially restored by other water running in to replace it from one side as well as another. In short, a well thus pumped down in a dry time serves to drain an inverted cone of soil, of which the bottom of the well is the apex, and the base of which may be a large area of the surface around the top. The distance from which such water may soak through the pores or cracks of the ground is quite indeterminate, and may often be far greater than the dimensions of a house-lot of an acre or more, so that any store of pollution situated on the same acre may have constant and ready communication with the well through the pores of the soil.

But, it is often argued, the soil filters the water and renders it quite clear and pure, and "the well water is very cool and refreshing." This notion, too, is far from being founded upon facts, and contains a dangerous fallacy. Such a conviction probably arises from the known absorbent properties of humus, or garden loam, and from the practice in vogue among all civilized people of burying their dead in the ground. But the soil of cemeteries is well known to have accumulated vast quantities of organic matter which is only partly decomposed, if buried as usual at a depth below the reach of a constant circulation of air through the pores of the soil. In fact, few people would wish to drink water from a well dug in a cemetery.

The conditions surrounding the ordinary cesspool or privy vault are not very unlike those about a tomb. The air has but little access to the decomposing matter, and the process of decomposition is therefore necessarily very slow. The surface-oil, or humus, rarely extends far below the surface, and even if it does, as in the prairies of Iowa, the air does not circulate with much freedom more than a few inches below the surface. The absorbent powers of the best humus are chiefly dependent upon the *air* in its pores, and the active decomposing agent is the oxygen contained therein. Just as soon as these pores become once filled or saturated with the filth of a cesspool or privy, the efficiency of such humus as a deodorizing or purifying agent ceases at once. Its action is at first partly that of a mechanical filter, by which the solid particles held in suspension are separated from the fluid, and partly a chemical action wherein the oxygen of the air held in the pores decomposes and slowly burns up the organic matter, even when held in solution. The water of sewage, after passing through such a filter and clarifier, may be limpid and sparkling, and may be cool and refreshing to the taste, while yet holding in solution a quantity of organic matter liable to rapid change upon exposure to the air, and capable of communicating disease with certainty and rapidity. The transparency, coolness, and freedom from bad taste is no criterion for the fitness of such water for domestic uses. Those qualities are, unfortunately, common enough in many poisonous mixtures, so that we can never rely upon the healthfulness of any water which is drawn from sources where this sort of contamination is possible.

But, it may be argued, the method of supply from wells is fast being abandoned in our towns and larger villages. Whenever circumstances admit, a public water supply is found and water distributed through the streets.

The possible advantages of such a method, when a proper and reliable source is found, are beyond question, but it must not be supposed that such an improvement renders the private cesspool and privy vault any more tolerable or less

harmful. A community may, it is true, thereby escape the poisoning of its drinking water, but many other and new sources of trouble arise, as follows:

As soon as water under pressure is introduced to houses in pipes, and the labor of pumping is saved, the consumption of water for domestic and laundry purposes, water-closets, bath rooms, etc., is found to increase at least five-fold. Indeed, unless more perfect fixtures than the average of those now sold are demanded and paid for at their higher cost, the leakage through the ordinary cheap fixtures will soon bring the consumption up to ten or twenty times what it was when supplied by hand-pumping. The quantity of filth discharged from the houses may not be increased, except as dependent upon an increase of population, but the volume of the house drainage which is thus sent into the cesspool is soon found to be beyond its powers of absorption. Many cases have come to my notice within a few years, where this trouble has become apparent to the senses, and many hundreds, yes, thousands of others must exist where the evil is going on in the hidden accumulation of filth beneath the surface, and though not apparent to the senses, it may exert an influence no less baneful to the health. Sometimes the cesspool overflows upon the surface, making a nasty, muddy place in the grass, overgrown with rank herbage. Sometimes it oozes through the ground, following along the outside of the house-drain that brings it, and soon makes its appearance under or through the cellar wall. I remember one case where it soaked in under a pile of coal, out of which the half-filtered and foul liquid slowly worked its way about the cellar floor. It frequently covers the mouth of the inlet in the cesspool, by which the usual circulation of air through the drain is stopped and the foul gas is drawn out through the traps in the basement story. The undue pressure finds new leaks in the drain, and works an untold amount of mischief in the dark, where least thought of and never seen. But even where the workmanship is perfect—a rare case—so that the fluid cannot come back or leak out within the house walls, the result is far from a desirable one. New overflows and additional cesspools are made, one after another, till every available place is exhausted, and the pollution reaches the boundary line of the owner's lot, and still no relief is found. The absorbent powers of the soil being soon overtaxed, the accumulation goes on, pressing into every available crack till the whole of the immediate vicinity of the house is a mass of corruption. The more water is used in the house, the worse is the nuisance. Repeated calls are made upon the apparatus provided for emptying cesspools and vaults by the public authorities, but as the soil becomes more and more saturated, these operations become so frequent that their cost is quite onerous, besides being a nuisance in themselves. Moreover, the soil about the house is becoming pestiferous. Emanations are going on constantly during the warm weather from soils in such condition, which are at least depressing to the vigor of the inmates of the house, if not actually poisonous. What is the rational remedy for this state of thing? I know of none but the removal, complete and thorough, of all house sewage, at once, constantly, and rapidly, from the immediate vicinity of the houses, and the abandonment of all vaults and cesspools or similar places where filth can be retained to putrefy within the limits of small house-lots.

In cities and villages where a public water-supply is provided, the removal of filth should also be provided by the public authorities, by means of well-constructed sewers. Hundreds of towns have recently found themselves in a dilemma by introducing a water-supply without sewerage. Sanitarians are all agreed that the former is no real advantage without the latter. The new complications arising as above explained will inevitably be followed by the penalties imposed by nature through her fixed laws, and it is the part of folly for man to ignore them and attribute the terrible results to "mysterious dispensations of Providence." Unfortunately, such penalties often fall upon comparatively innocent parties. No man can trace the exact source of many individual cases of disease, which are, however, as a class clearly attributable to mistaken ways of living in the whole community.

It follows, therefore, that public authorities should more fully realize and study their responsibility before undertaking enterprises which may complicate rather than relieve the public needs. The subject is a broad one, deserving far more study and attention than it has hitherto received.

There are, however, a large number of cases where a public water-supply is not afforded, and where the construction of sewers would be a still more serious burden upon a scattered population. The remedy for them cannot, perhaps, be through combined action, but it should be governed by the same considerations as to speedy and thorough removal of all refuse from the neighborhood of houses, and the avoidance of all accumulations in cesspools or vaults. Wherever ample land surface is found, *i. e.*, where houses are surrounded by lots of an acre or more for each within their control, the question is a comparatively simple one. But it becomes more difficult on smaller house-lots and in villages, though of still greater importance in proportion to the nearness of the houses to one another, and the consequent crowding of wells, vaults, etc.

The most rational and approved methods of disposal of house-drainage, whether from large towns by combined action through sewers, or from small villages and detached houses, are as follows:

First, where nature provides deep and copious streams or deep tidal waters, to use these for such disposal, though this method is rarely applicable to a scattered population.

Second, to distribute the fresh sewage on or near the surface of the soil by irrigation, a process equally available whether upon a large or a small scale, though somewhat more costly in the latter case.

The exact methods to be pursued to accomplish this in detail must vary with local circumstances. The cardinal principles to be observed are these, viz.:

Never allow a receptacle of fecal matter or liquid filth to accumulate any store of it for putrefaction, but keep it moving till it can be distributed upon or near the surface, and see that such distribution is so effected as to avoid the saturation of the soil or the collection of the liquid in pools.

Use if possible two fields alternately for the absorption of the fluid, allowing each in its turn to rest for such a period as may allow all the liquid to soak down a foot or more below the surface. This will insure the entrance of fresh air into the pores of the soil as the water subsides, and this air is, as above explained, an important agent in the decomposition of the organic matter retained by the soil in the process of filtration. Grass is found to be one of the best crops for general use upon land used for sewage irrigation. Its stubble prevents the surface from being washed, and assists in the uniform distribution of the fluid, while its roots readily absorb and appropriate a very large amount of the organic matter.

It has often been objected to the process of sewage irrigation that it must necessarily make a nuisance in itself, and that we therefore only transfer the trouble to another locality. But experience does not justify this objection. The process is now in use in a large number of English towns, as well as on the continent of Europe, with no such prejudicial results.

Dr. W. H. Corfield, at a recent meeting of the Sanitary Institute of Great Britain, in London, while alluding to the subject of sewage farms, stated that "the supposed dangers from the vicinity of such farms or from the spread of entozoic disease were found to be purely imaginary. It was, on the whole, a better solution of the question for a large number of places than any other, and if, as was very likely, we had a series of dry years, its adoption would receive a great impulse."

I would also invite attention to the practice of distributing sewage on the surface, which has been pursued for over a year at the asylums for the insane at Worcester and at Danvers, Massachusetts, and at Augusta, Maine. All of these instances, though rather crudely developed, and involving some objectionable details not essential to the process, have, nevertheless, been so far successful that they have not yet been followed by increase of disease, but rather the contrary.

In short, experience as well as theory has taught us that the processes of vegetable growth are the readiest and safest agents for the disposal of all our organic refuse. Nature provides that the animal and vegetable kingdoms shall each absorb and retain for its use the elements which are rejected as harmful by the other. Plants feed upon carbon contained in the carbonic acid which animals excrete from their blood in the lungs, and also feed upon the ammonia evolved by the decay of all kinds of fluid and solid animal excretions. On the other hand, man, like all other animals, absorbs oxygen as an essential agent in all the functions of his development and growth, an element which all plants reject, while absorbing the carbon from the carbonic acid of the air.

We have, therefore, only to avail ourselves of this universal law, and to conform our lives to it in detail, in order to attain the most healthful development that is possible. It is through our ignorance and our stupid violations of such laws that most of our suffering and disease is brought upon us.—*American Architect.*

PLOWS AND PLOWING.

WHAT IS GOOD PLOWING?

THE season has again arrived when letters are received asking that same old question that has been asked more than ten thousand times, "Which is the best plow?" and a question that has never yet been answered, and probably never will be, so long as soils vary in character and people differ in their tastes and habits.

It was not long ago that we heard a popular agricultural lecturer make the statement that there had been no improvement in the shape of plows for the last fifty or seventy-five years; that a plow which he saw used in his boyhood days turned just as good a furrow as any plow that has been invented since. In a certain sense the statement may be nearly true. We know other prominent men, especially prominent at cattle-show plowing matches, who keep an old plow that was made at least forty years ago, for the especial purpose of plowing at fairs, because they have found that committees will often give premiums for just such work as these plows will do.

If the claim is made that some of the old style landside plows will turn just as flat a furrow and lay it over just as smoothly as any plow recently brought out, we should not be disposed to dispute the claim. But a smooth, flat furrow is not the only point to be observed when judging of a plow or its work. It is true that one object of plowing sod land is to dispose of the sod so that it will not be in the way of subsequent cultivation. To do this the furrow slice must be more or less inverted, and no plow can be said to be doing good work when it sets its furrows so much upon their edges that the grass will grow between them or the turf turn back under the harrow. But while the sod must be inverted and vegetation buried, the furrow itself must be left as thoroughly pulverized as possible. The old-fashioned cattle-show, prize-taking landside plows do not crumble and disintegrate the furrows, as do some of the more modern patterns, both in the landside and swivel class. With the general introduction of the disk harrow, flat-furrow plowing is no longer absolutely necessary, for these harrows will follow almost any plow without turning back or tearing up sods.

THE SWIVEL PLOW THE LEADING PLOW IN NEW ENGLAND.

As readers of the *New England Farmer* are already aware, we are very much in favor of the swivel plow, not only for hillside, but also for turning level land. Since the mowing machine has found a place on almost every farm, and division fences and small fields are growing unpopular, those plows and other implements which leave the land unbroken by ridges and dead furrows are rapidly gaining favor. One need only glance at the advertising pages of any New England agricultural journal to see what plows sell among our hills and valleys.

Western manufacturers have made great improvement in the landside plow within the past few years, and many of their new plows have been sold in New England, but the swivel plow, we believe, is the leading plow with our foremost farmers. There are yet a great many old-fashioned plows in use that ought to be melted and run over into better forms. A carpenter who should use tools as far behind the age as are some of the plows that are still in use would find it difficult to obtain employment. We not only use plows that are out of date, but we use the points till they are so dull that good work is absolutely impossible.

One inquirer writes that he has never yet found any swivel plow with which he could do as good work as he can do with some of the landside plows, and wishes us to inform him whether among the newer patterns of swivel plows there is one that ought to suit a farmer who is accustomed to the use of landside plows.

ANY PLOW REQUIRES A GOOD PLOWMAN.

Now, we hardly know just how to answer such a question. Workmen often become very much attached to tools with which they are familiar. How many farmers honestly believe they have the best mowing machine that is made, simply because they happen to have one of a great many good machines, though they know very little of the character of any except their own. Their own machine they have become familiar with, and are capable of getting all the work out of it that it is able to perform. Now, every plowman knows that before he can get the best work out of any plow he must have learned the "feel" of the plow, just as the mower must get the "hang" of his scythe. There possibly may be a best way for a scythe to hang, but a good workman can adapt himself to different methods of hanging. So can a good plowman do good work with more than one form of plow after he has become familiar with it. It is not an easy matter, however, for every one to plow with a swivel plow at the first attempt; even if they make fair work turning the right-hand furrow, they are almost certain to balk on the return.

We have had a good deal of experience introducing swivel plows to novices, and have found a great many farmers who could not turn a good left-hand furrow. They really believed that the plow was imperfect, when the fault was wholly in themselves. No man can ever do first-class work with a swivel plow until he becomes familiar with the "feel" of a left-handed plow. In some parts of Pennsylvania it is the custom among German farmers to use left-hand plows, and they would undoubtedly find fault with our swivel plows, but would complain of the right-hand furrow.

HITCHING TO A PLOW.

Not all—we were about to say, not half—the men who use plows, know how to hitch to any plow in order to get from it the best work. Many farmers hitch at haphazard, with wheel cutter and clevis just as they find it, and with any length of chain that comes most handy, while the best work can only be done when everything is perfectly adjusted. Few farmers' sons are *taught* how to plow. They are put between the handles and then left to learn as best they may. While visiting the Agricultural College at Amherst we saw in President Stockbridge's class-room an old landside plow all in pieces. It was not worth for plowing twenty-five cents, but it was just as good for his purpose as a twenty-five dollar plow. His students, before going to the field, were taught in the class room how to make a plow, or at least how to set one up and how to adjust it to the team and to the work desired. They were told why the iron work of an ordinary landside plow is not set in a direct line with the beam but partly across it, the point toward the unplowed land; because otherwise, with the length of yokes and double trees in common use the plow would fail to take sufficient furrow. The farmer who tried a new plow, left at his farm by an agent, and who worked with it all day without discovering that the clevis pin was on the near outside of the beam, thus throwing the plow away from land and vexing him most severely, was probably not one of Prof. Stockbridge's pupils. And yet this is not a solitary case of blundering. We have known pretty good farmers to nearly wear out a plow before learning the use of some of its most important features.

According to our experience and observation, if ten good swivel plows were put into the hands of ten farmers who had never used a swivel plow, nine would fail to properly hitch them to their teams unless special instructions had been given them by the agents. The most common failure is from using too short a yoke or double tree, bringing the near and off animals too near together. So long as the furrow animal keeps his place every two inches added to the length of the yoke carries the plow one inch further toward the land and so cuts a wider furrow. A plow drawn behind a four-foot yoke will take a furrow fifteen inches wide instead of twelve inches if drawn by a yoke three and a half feet long, the bow holes in each case being at the same distance from the ends. A good two-cattle plow, like the Matchless No. 2 A, Centennial No. 3, I X L No. 6, Charter Oak 160, and others we might name, should take furrows at least twelve inches wide on the average; but if the yoke or evener behind which they are drawn is six inches too short, then they will lay out but nine inches—a furrow far too narrow for these plows, and consequently poor work must result. The furrow slice *must* be wide enough and deep enough to keep the plow balanced between the furrow and the unplowed land. It is this loss of balance that makes it so difficult to turn the last or clearing out furrow in landside plowing.

So, to most inquirers for the best swivel plow we are inclined to answer, first, let us know if you can hitch up and hold any plow as it should be hitched up and held. Have you learned the first principles of plow construction? The truth is, manufacturers of swivel plows have not had so much difficulty in making properly shaped mould boards as they have in setting up their plows so that they could be used by such men and teams as would be likely to hitch to them. The manufacturers of the Matchless plows, by their published circulars and directions for using, have done perhaps more than any other firm to educate farmers up to the use of swivel plows, and this may be one of the reasons why these plows have so long held their place, in the opinion of many, at the head of this class of farm implements.

One writer asks if there have been any important changes or improvements made in swivel plows within the past year or two. To this question we can answer unhesitatingly, yes. The Matchless plow has been greatly simplified, improved, and cheapened within the past year. The complicated and expensive hinge cutter has been discarded, and in its place a plain steel cutter is set in the middle of a rocking beam, which throws the cutter in line of draught at each turning of the mould board, making the plow both simpler and stronger. The Centennial plow, we believe, has been furnished with a hard metal mould board. The I X L is a new plow, and when used in soils to which its long, easy-moving mould-board is adapted one is apt to think he has really found *the* plow. The "1876" is a new swivel in both steel and chilled iron, and is a good plow. The Syracuse swivel, which is liked so well by those who saw it work at the "Pine Hedge Farm" trial last fall, is a plow that promises well, but the manufacturers are still at work perfecting it in some points before pushing it upon the Eastern market. It is not unlikely that the iron and steel beams will both be changed for wood beams before New England farmers will be suited with it. One peculiarity of this plow has been that it takes land so freely that a shorter yoke and evener is required than are in common use.

Another new plow whose merits deserve that it should be more known is the "North American," made in Barre, Vt. The prominent feature in this plow which makes it unlike any other is the movable clevis under control of the man at the handles. By moving a short lever, the clevis can be thrown to the right or left of the line of draught, and thus force the plow to take whatever width of furrow is desirable. As the one great difficulty in using swivel plows has been to govern the width of furrow, it will be seen that this device must add much to the popularity of this form of plow. It is not improbable that other improvements may

yet be added to all the plows named: but either if put into soils to which they are adapted, and held by plowmen of some experience with swivel plows, will do work that will be worth as much to the farmer as any of the old-fashioned landside plows.—*N. E. Farmer.*

COFFEE.

THE United States furnish the best market in the world for this most valuable production. We had read with more or less attention the history of coffee and the methods of cultivation, but not until we had a beautiful tree in our conservatory, grown from a berry of our own planting, did we understand the description or realize the extent of the popular ignorance in regard to it. The stately shrub passed through several years of growth, changing its position from the greenhouse in winter to the shaded lawn in summer, before it condescended to become fruitful. The foliage is very beautiful, the evergreen, leathery leaves being oblong ovate, three or four inches in length, growing in pairs from opposite sides of the branch, and of a beautiful luster, as if they had been varnished.

The blossoms spring out from the axils of the leaves, making their first appearance as a tiny white spear nearly an inch long, standing up at right-angles with the branch, and when open are remarkably fragrant. They are each of them frail and short-lived, however, seldom lasting for more than twenty-four hours. A plantation must be very beautiful thus suddenly donning this snow-white apparel to contrast with the rich green of the foliage. Just around the angle of the leaf and branch the blossoms cluster, and soon change into the tiny beginning of the promised fruit.

We cannot recall a single visitor, not familiar with a coffee plantation, who did not express surprise at the character of the growth. They all supposed that the coffee berry grew in a pod like beans or peas, and could not realize until they saw it that the product of the tree was a delicious fruit like a cherry, although with a thinner pulp, and that the berry it carried in couplets was the pit of the fruit like a "cherry-stone," to be obtained only after the fruit had ripened and wasted.

Sometimes a single blossom and fruit appears at the axil of each leaf, but more frequently they are found in clusters containing three or four on each side of the branch. They are a little oblong, but in other respects resemble a small cherry in appearance, being first green, then a pale red, and when ripe a reddish purple. They are sweet, perhaps a little insipid to some tastes, but very palatable.

In tropical countries the tree is "topped" to keep the branches within convenient distance from the ground, and eight to ten feet is the average height permitted. If allowed, the tree would grow to a height of twenty feet, with but few lateral branches. In dry climates irrigation is necessary, and in Brazil the plants are often shaded by larger forest trees, as a better quality is obtained by a little protection from the sun. The trees blossom there for eight months in the year, fruit being constantly forming, and there are usually three pickings within the twelve months.

A tree will produce from two to six pounds per annum, and will bear for twenty-five years, although they are usually cut down at the end of fifteen years. A field hand will pick about thirty-two pounds a day. As a rule, no attempt is made to separate the "seeds" from the fruit at the moment of picking. The fruit is placed on mats or large floors to dry, and is frequently stirred to prevent injury. When dry it is passed between heavy rollers, which crush the dried skin and pulp and release the berries. Each berry is inclosed in a thin yellow membrane, which is very brittle when dried.

The two berries are in separate cells, their flat sides together. If one berry becomes abortive, the other grows round, and fills both cavities. Such round berries are frequently found in nearly every parcel of coffee. If one of these round berries is planted and vegetates, it will produce a tree that bears a fruit with only round berries, and the somewhat celebrated "pea berry" or male-berry coffee is thus obtained.

The leaf of the tea plant (which we have also raised from seed) is not unlike that of the coffee tree, and the active principle of both is the same. The theine of tea, and the caffeine of coffee, are identical, and the latter, as may not be generally known, is found in still greater strength in the dried leaves of the coffee tree (prepared like tea) than in the coffee berry itself. In Asia the beverage is made very largely from the unroasted berry, and often also from the dried pulp of the fruit. In roasting a full brown color the berries will lose about 20 per cent. of their weight, and gain nearly 50 per cent. in bulk.

It is a great mistake to purchase the old, long-stored coffee at the higher prices generally demanded, with the idea that it makes a more delicious beverage. "Old" Mocha, and especially old government "Java," have been held in high esteem by some epicures, who have accustomed themselves to their peculiar flavor, and this fashion has been followed by others who supposed the example worthy of universal imitation. A very little reflection will show to any intelligent person the absurdity of this preference. The best aroma of coffee is exceedingly volatile, and the utmost pains is taken to prevent its escape in the process of preparation. To keep a coffee berry for several years until the best part of it has dried out, and then to take such exceeding pains to preserve the remainder, is to "spill at the bung and to spare at the spigot." Coffee, like tea, is best when newest, and those who have once acquired a relish for the fresh green coffee will never again select in preference that which has lost the best of its flavor from the lapse of time.

This country imported in the fiscal year 1880 from all foreign ports 446,850,727 pounds of coffee, valued at $60,880,769 at its foreign cost. To this must be added the freight and profit of the importer and dealer to show the cost to consumers. There is now no duty on coffee that comes directly from the place of its production. Two-thirds of the whole importation last year, 296,731,718 pounds, came from Brazil; 35,518,910 pounds from Venezuela, 28,033,008 from the Dutch East Indies, 22,659,285 from Hayti, 19,254,218 from the Central American States, 12,687,423 from the United States of Colombia, 9,878,535 from Mexico, and the remainder from various other parts of the world.

It is unnecessary, perhaps, for us to say that a large part of the coffee which is sold as the ground berry, ready for use, is adulterated, and is very unlike the genuine article. Chiccory root is the best of the mixtures, but dandelion root, carrot, split peas, and a great variety of other substances, are used to cheapen the product. They are all destitute of caffeine, and fail therefore to give the stimulating effect produced by the coffee. Even if the preparation was pure, ground coffee is not fit for use a few hours after it leaves the mill. A family may purchase its coffee already roasted, but the grinding should be done in the kitchen at the moment of preparation. It may then be boiled in a close vessel, or simply infused, and it is a refreshing drink, well calculated to lessen the daily enormous waste of the animal frame.—*N. Y. Journal of Commerce.*

PROFITS OF FRUITS AND VEGETABLES GROWN IN FLORIDA.

IN treating this topic I am well aware that only approximate statements can be made, and even these are varied by differences in soil and methods of cultivation, and nearness to, or remoteness from, navigable waterways or railroads. I now speak from my own knowledge of what can be done at Crescent City, Putnam Co., Florida.

Of the orange, banana, and pine-apple I can speak with more certainty than of any other product. Upon each acre of ground seventy-five orange trees may be successfully grown; some persons plant more than this number per acre, but I will assume 75 trees as a basis of my statement; when in full bearing it is far within the truth to estimate 1,500 oranges as the annual yield of each tree, and it is not at all difficult to realize $10 per 1,000 for them, which gives the aggregate of $1,225 per acre per annum. A grove of five acres would, therefore, yield $6,125 per annum. Many orange growers in different parts of the State have informed me that the average on full grown trees will be nearer 2,000 than 1,500 oranges. I believe this is true, but prefer adhering to the safe estimate.

Orange trees that are three or four years old when set out, may, by budding, be brought into bearing in three years; the first crop will be light, but upon a five acre grove will be quite sufficient to support an ordinary family until the next crop is matured. Every succeeding crop, for a number of years, is heavier and heavier, until the maximum is reached. An orange grove, properly cared for, will continue to bear for more than a century, and thus the fortunate proprietor of one has a permanent source of wealth and ample leisure as well.

Pine-apples are propagated by setting out the suckers or shoots of mature fruit, and come into bearing the second year, and continue bearing annually, without further planting, for from five to eight years, when new fields must be planted. Some thousand or more plants may be successfully planted upon one acre, and the net return of the crop should be $15 per hundred, which would yield an annual income of $1,050 per acre. Therefore pine-apples, at the first glance, appear to be equal, as a paying crop, to oranges; but it is believed that, in the long run, the orange grove will pay the best. The consumption of the orange is much more universal than the consumption of the pine-apple, and will always continue to be. As the pine apple is a summer fruit, maturing in June, it is one of the best products to plant in connection with the orange.

The banana has as yet not been very extensively planted in Florida, but in all situations where the pine-apple thrives, the banana will also succeed, except that the banana requires a richer and moister soil than the pine-apple. Like the pine-apple, the banana is propagated by planting out shoots or the suckers from a matured stock, and will bear from the second year, and annually thereafter for an indefinite period. It requires no cultivation, and only needs to be let alone, to grow and constantly enrich its owner. About 500 plants may be successfully grown upon one acre. As each plant "shoots" and produces from five to seven bunches of fruit, it follows that the return to the grower at, say, fifty cents per bunch, would be from $1,500 to $1,700 per acre. Thus it will be seen, that, wherever the proper kind of soil exists, it will pay to plant bananas. The banana comes into market later than the pine apple, and is a good succeeding fruit to market before the orange season begins.

To convince my readers how far within the truth I endeavor to keep, I will say that a party in Bradentown, Florida, has just sold his banana crop off from one acre for $3,000. Any one desiring to verify this statement is referred to Mr. William Gifford, Bradentown, Fla., where the pine apple and banana can be grown. The lemon and lime will also do well. The lemon tree comes into bearing earlier than the orange, and is a more prolific bearer, though about the same number of trees are put upon each acre. The lemon is a safer fruit to ship than the orange; is not so perishable, is more universally consumed, brings nearly the same price per 1,000, and may be gathered nearly every month in the year. The lime tree is also a very prolific bearer, and comes into bearing in four years from the seed.

Of the profits realized upon the grape fruit, citron, guava, shaddock, sappadilla, sugar apple, tamarind, date, fig, and pomegranate, I am not now qualified to speak. The cocoanut is a good paying tree; the yield annually is about 150 nuts per tree; they come into bearing in seven years after planting the nut, and there can be put about 300 trees upon one acre. They require no cultivation, and there is no risk in shipping them. Allowing a net return of 300 per tree to the owner, an acre would yield an annual income of $900. Respecting the profits upon small fruits and early vegetables, I can only say that results are as various as gardeners are numerous; but it is evident, from the rapidity with which the business is extended, that satisfactory profits are realized. Potatoes, cabbage, cucumbers, tomatoes, and melons give the least trouble, the strawberries probably pay the best per acre.—*L. A. Ballard, in N. E. Farmer.*

FLOORS FOR HORSE STABLES.

THE Germantown *Telegraph* says: "The long-debated question as to the best material for stable floors is being again revived. A clay floor was adhered to by some for years, and such was the earnestness of its advocates and the many arguments brought to bear upon it, that we were induced some twenty years ago to try it. In three or four months we had the planks back again, being satisfied of the disadvantage of clay for this purpose. Our present floor of plank is simply inclined a little from front to rear, where the usual gutter is made to carry off the liquid voidings. We do not believe in sand, coal ashes, sawdust, asphaltum, flags, cobblestones, or any of these modern devices to injure horses. Thus far we have never noticed that this little inclination was in any way injurious, and we doubt whether the wooden grating that we frequently see placed over the planking that some use would be advisable, on the ground that the animal would be no more comfortable, while this movable grating or second floor might lead to accidents.

"When a person can keep horses in good, sound, healthy condition for five to seven years, as we have done on a carefully constructed plank flooring inclining a little to the rear, it is just as well to be satisfied with it. Do what one will, holes will be dug by the stamping of the feet in the clay, and these will be filled with moisture which will necessarily result in scratches, quarter-crack, etc. If the clay is leveled off and beaten down daily it will make no difference. Some time ago we inspected a number of stables where many horses were kept, and we encountered only one which was composed of anything but wood. Of course there will be new things—inventions—springing up, which are to meet and overcome every objection, and there will be some to adopt them, but we shall be satisfied with what we have until there is something produced about which there will be no mistake."

DURABILITY OF REDWOOD.

THE general durability of our redwood timber and lumber is becoming widely known, and is leading to a promising export trade, as we have noted from time to time in the *Press*. It seems that the durability of the wood in situations which lead other woods to quick decay, may be the foundation of a special trade in redwood. At all events, wood of long life under adverse conditions is such a desirable thing to Eastern builders, that they are inquiring the record of our redwood in this respect. All who have had to do with it here know very well that it has remarkable durability underground or between wind and earth. In order to present Eastern correspondents an object lesson in the soundness of redwood, Fulda Bros., of Spear street, S. F., who are exporters of lumber, have just sent East a piece of one of the posts which formed the stockade of Fort Ross in Mendocino county, accompanied by certified statements concerning the history of the specimen, which are of general interest, and we publish copies of them as follows:

"MESSRS. FULDA BROS., S. F.: By your request I send you, by the schooner Euphemia, a piece of the old stockade at this place. The stockade was built by the Russian Fur Company in 1811. Eight years ago, as the stockade was in my way, I had most of it cut down level with the ground, and the sample which I send you is a piece (about a quarter) of one of the butts of the posts left in the ground. In getting your sample, we only took up one post, and it is about a fair average. As you will see, it is perfectly sound, excepting the sap wood, after being buried for seventy years.—G. W. CALL, Fort Ross, Sept. 13, 1881."

"State of California, City and County of San Francisco [ss.]: I do hereby certify and declare on oath that the piece of redwood lumber referred to in the within statement was taken up by me from the original stockade erected by the Russians in 1811. It was standing buried in the ground, excepting the upper end. The whole piece being too heavy, this was split off from the log, it being about two feet thick.—H. BOTCHER, Captain, schooner Euphemia.

"Sworn and subscribed before me this 14th day of September, 1881, John E. Hammill, Notary Public."

Here, then, is a piece of a redwood post which has been near the surface of the ground seventy years. As Mr. Call says in his statement, the post was perfectly sound excepting the thin layer of sap wood on the outside. This had decayed, but the balance was perfectly sound and as bright colored and solid as though it had been fresh from the lumber yard. The alternating soaking and drying of the ground for seventy years had left no effect upon it, and it is impossible to tell how long it would have endured. Seventy years' duration will, however, satisfy the ambition of most modern builders, and it would not be surprising if our redwood should be called for on account of its durability, and a profitable trade arise.

In this connection it is interesting to mention a fact concerning the second growth of redwood which Mr. Call of Fort Ross relates. He knows of shoots from old stumps which have grown to be three and four feet in diameter in forty years. This would indicate restorative powers in redwood forests which would insure a future supply of the timber.

The redwood which is in demand here for underground use is what is known by the lumbermen as "black heart redwood." It shows a dark color when cut with a knife, the outer layer only becoming "seasoned." "Black heart" is exceedingly heavy; too heavy to float. One who has observed schooners loading at chutes along the coast assures us that a post of this wood which plunges overboard never rises, and a board lingers on the surface a moment and then slowly slides down into the depths. This is the sort which is sought for in the foundation of our buildings, and under brick walls is believed to be imperishable.—*Mining and Scientific Press.*

INSECTICIDES.

By DR. H. BEHR.

AT a recent meeting of the California Academy of Sciences, San Francisco, Dr. H. Behr read the following paper on the subject, "Is Bisulphide of Carbon an Insecticide?"

It certainly is, like many other substances, when applied in sufficient quantity and for a sufficient length of time. There exists a considerable number of such substances, all of them more or less expensive, more or less dangerous in their application, more or less injurious to vegetation. According to experiments made by me, bisulphide does not begin to be an infallible insecticide before having inflicted serious injury to vegetation. It is a well-known fact that insects, apparently dead, frequently will recover their full vital energies when removed from the cause of their asphyxial state. For instance, moths having been immersed in sulphuric ether will recover after the evaporation of the ether. *Coleoptera* (beetles) will recover from the effects of chloroform; flies, sometimes after having spent a whole day in a bottle of wine.

THIS LATENT VITALITY

Is possessed even in a higher degree by the eggs of insects. We safely may assert that at the present state of our knowledge, there exist only two kinds of insecticides perfectly reliable, and at the same time harmless to vegetation.

1. Fatty substances.

2. A certain group of composite flowers. The first acts mechanically; the second dynamically, which, to talk honestly, means its action cannot be explained at the present state of our knowledge.

The action of bisulphide of carbon is chemical, but not sufficient to obtain the desired object, if supplied in a form and measure that would not inflict injuries to vegetation more disastrous than the evil against which it is applied.

FATTY SUBSTANCES

Act by spreading in a film over the surface of the insect and closing the spiracles, so that they exclude the air from the tracheal tubes and suffocate the insect. These substances,

so harmless to vertebrate animals, kill insects quick as lightning and without leaving them time for a death struggle. As the fatty substance remains on the body, resurrection of the insect never takes place, which, as mentioned before, is frequent after the action of evaporating substances like ether or irrespirable gases. With the exception of a few cases, for instance, codling moths, some geometrides with apterous females, etc., we have no means to administer this infallible insecticide in a way that it reaches the insect pest whose destruction we intend. In regard to the phylloxera, or any other subterranean or endophagous pest, the application of fatty substances is entirely out of the question.

THE ACTION OF THE COMPOSITE FLOWERS

Of the Anthemis group is of a different nature, but nearly equally powerful. These flowers are generally applied in a powdered state called "Persian insect powder," and destroy insects by paralyzing their nervous system. The most energetic species belong to the genus pyrethrum, but even our *Artemisia filifolia* possesses sufficient power to destroy the more delicate forms of insect life. I do not know if chemistry has established what the active principle is, but it seems that the different species of the group differ from one another more by the quantity of the active substance than by its quality. Unlike the fatty substances, their specific or dynamic poisons do not act with the same energy on the whole insect world. Some insect forms seem exempt till the powder is well mixed with water; some will cross a line of the powdered substance in the open air with impunity, but will succumb in a room where the exhalation of the substance has more chance to collect round the animal. Notwithstanding all these uncertainties, the Anthemis group may become a valuable insecticide, when we have invented methods for its application in field and garden. At present we have used it nearly exclusively for our own protection and that of domestic animals. As to the latter, some precaution perhaps may be necessary in its application, because some instances lately have been noticed where it appeared not quite as harmless to vertebrate animals as it was supposed to be. There are several other substances known that will act as insecticides, but their effects are either limited to certain groups of insects—for instance, quassia on diptera; borax, on cockroaches; cimicifuga, on bugs—or they will act only in a certain condition—for instance, tobacco, only as smoke.

BISULPHIDE OF CARBON

Belongs to a third series of insecticides. It belongs to those that act chemically. As the ultimate chemical composition of organic matter is pretty much the same in the different provinces of creation, the action of these insecticides is not a specific one—that means, it is not restricted to the pest against which it is prescribed, but acts with similar intensity on all organisms with which we cannot avoid to bring it in contact, if we want to produce the desired effect on the insect pest. Bisulphide of carbon, for instance, acts much more powerfully on animals breathing through lungs than on such breathing by spiracles, like insects. It destroys in much shorter time a frog, a toad, or a mouse, than a butterfly, a beetle, or an aphis. It also destroys them more effectively, for it seems frog, toad, or mouse do not revive, as insects sometimes do, when they are removed from the exhalations of bisulphide. Eggs of insects stand the action of irrespirable gases for a much longer period than larva, nympha, chrysalis, or imago, but I have no data on their power of resistance.

EFFECT OF BISULPHIDE ON PLANTS.

Bisulphide of carbon extends its influence on organisms classified with the vegetable kingdom. It exercises considerable power on all cellular plants, especially on fungi, perhaps to the extent of destroying their resting spores. Less powerful, but at the same time also less desirable, is the effect of bisulphide of carbon on vascular plants, to which class, for instance, belongs the grapevine itself. I am afraid the injurious effects of the bisulphide on cultivated plants have been underrated, and I think it high time to direct the attention of the farmer and the horticulturist to a danger, that, instead of diminishing his troubles, is apt to add considerably to them. I do not refer solely to my own experiments, begun the 16th of May, 1880. They could not be otherwise than on a small scale, and my observations frequently were interrupted by professional duties. I was at first diffident in drawing conclusions from them, or else I would have placed them much sooner at the disposal of the public. But the

RESULT OF THE INVESTIGATIONS

Of others, commenced on a larger scale, coincides in all the main points with my own, and so I feel justified in making the following statements:

1. Bisulphide of carbon is injurious to organic life in general.
2. Its action is quicker on animal life than on vegetable life.
3. Its action is more transitory on animal life, more permanent on vegetable life.
4. Its action on insect life is considerably slower and less permanent than on the life of animals that breathe through the lungs.
5. Its action on vascular plants is insidious; that is, it frequently does not begin to show before the plants are beyond recovery.

It is possible that a dynamic insecticide of practical use may be discovered. It is improbable that a chemical insecticide killing the phylloxera, without injuring the vine, ever will be discovered. Till such an insecticide has been found, we have to use the inundation plan, and where that is not practicable, either quarantine the infected spots by the destruction of the healthy vines in the periphery of the infected spot, or, for instance, if destruction has already gone too far, we have to graft on the æstivalis, riparia, Californica, or some other fungus-proof vine.

MILDEWS AND MOULDS.

By A. G. FIELD, M.D.

MILDEWS are generally the *Oidium tuckeri*, or the *Erysiphe*, of which there are several varieties. They are creeping, vine-like growths, about one three-thousandth of an inch in diameter, that form an entangled web upon the surface of the leaf, excluding the air and suffocating the plant by obstructing its respiration. There are others of which the whole class *Uredinei* are examples, that penetrate the substance of the plant or fruit, and, leech-like, steal away its substance and vitality; and others again, that first poison the victim, then fatten upon its decomposing tissues. The large number and variety of microscopic plants is indeed marvelous, greater even than is presented to our unaided vision in the widest range of botanical knowledge of every country and climate. The little speck of mould that forms in a few hours upon a piece of bread, and seems like the merest touch of some discoloring substance, is a great forest of little plants, the *aspergillus glaucus*, with roots and trunks and branches, some old and fallen, some mature, and others just budding into life and beauty. Almost every object in nature affords a congenial habitat for some class or species of microscopic plants. Their little zoospores and seeds float in the purest air we breathe, and course the minutest blood vessels of the human body. The groups of little *torula cerevisiæ* that convert hops and water into "lager," or the little *yeast plant* that inflates the wheaten dough with carbon, and renders it porous for the baker's oven, are living bodies, not less plant-like in structure than the oak or elm; and the little forests of *protococcus nivalis*, that bloom amid the crystals of snow flakes, and clothe the Alpine hills and polar snows in blue and crimson, are not less plants than the orange tree is, whose fruits and fragrance delight the senses of mankind. If clothing becomes mouldy, little *fungi* are "trying it on," and if catchup becomes ropy, little *penicelli* are going for it.

In its relation to the interests of horticulture, this subject presents two questions for consideration:

1st. The circumstances or conditions affecting a fruit or plant which favor the germination and growth of microscopic organisms upon them.

2d. The means of destroying the cryptogamic parasite without injury to the infected food or plant.

Our knowledge is too limited to say much on either of these questions that is satisfactory even to ourselves. But we know that the contest between the forces to which matter owes allegiance, produces the various phenomena of the natural world. In the phenomena of growth as applied to living bodies, vital force obtains the ascendency over the physical forces, and certain molecules of matter are become endowed with the attributes of life.

So long as each part or organ maintains a harmonious relationship in form, position, and the proper performance of its legitimate function, to the others and to the whole as a unit, the condition is health. But discord in any of these, if persistent, sickens and weakens the part, and chemical forces, always on the alert to reclaim their own, contest successfully the jurisdiction of the vital forces, and degenerative molecular change ensues. If in a plant, it may be in its respiratory organs, the leaves, or in its integumentary investment, the bark, or in the cells or cuticle of its fruit. But the sway of chemical forces is ordinarily of short duration. They scarcely possess the tenement before they are again assailed by other vital forces in the form of invisible germs of microscopic plants, and new life marshals the wandering atoms of the old temple into new forms and structures. The change may be partial, affecting but a single organ or member, or it may involve the whole body and its death.

The conditions which secure a uniform and healthy growth of plants are: a due amount of sunlight and moisture, a proper temperature, proper constitution of air and soil, with not too much culture to produce plethora, nor neglect to result in inanition. How to secure these is the proper study of the horticulturist. A want of them results in disorder of the physiological functions of the plant, the supervention of chemical change and the development of cryptogamic parasites, to prey upon an easy victim.

If a plant has already become infected, it is of first importance to use every precaution to restore a healthy growth by means already suggested, and then to destroy, if possible, the cryptogamic organisms. For this purpose the fumes of sulphur would no doubt be serviceable, or the fumes of tar or coal tar, as the one contains carbolic acid and the other creosote; or even the smoke of burning wood, as they are all regarded as among the most useful agencies in arresting the development of microscopic germs.

ST. HELENA AS A CALL PORT.

To the Editor of the Scientific American:

In looking over your valuable journal, on file in this Consulate, I find that this little island has never been represented, and I feel that it is my duty to make a few remarks in reference to the advantage to be derived by our American shipping calling here oftener than they do.

It is unnecessary for me to give the position of the island, as every schoolboy is well acquainted with its locality, and for what it has long been noted, as the resting place of one of the world's greatest heroes.

SOIL AND PRODUCTS.—In the first place, in reference to the fertility of the soil and its products, everything grows in abundance, vegetables of all kinds, and many fruits that are found in the Tropics, as well as those found in our well-favored land.

FARMS.—There are several very large farms, the largest of which is the farm at Long Wood, owned by Thomas Deason, Esq., having some 350 acres under cultivation. This year he produced some 2,000 bushels of potatoes, which were being sold at $2.50 per bag of 112 lb. weight, and if ships would make a point of stopping here on their passage to and from the East Indies and China, it would induce the farmer to raise more crops, so that everything could be sold as reasonable as they are in our own country, but if there are no shipping the home consumption is not enough to guarantee sufficient revenue to induce them to plant, so instead of tilling the soil, they depend upon their stock for support.

COFFEE grows remarkably well, and, I believe, is pronounced by competent judges to be equal to the celebrated Mocha.

FLAX, of a very superior quality, is found on most of the hill sides, and, for several years past, a company called the Colonial Fiber Company has been utilizing it, but, on account of poor machinery and the want of funds, the company has been compelled to close, but the enterprising foreman, Mr. Davey (late of H. M. R. E.), has courageously taken the matter in hand, and several of the gentlemen of the island have offered to render him assistance. He has invented a very simple and novel machine for cleaning the flax, which bids fair to be a success, and if so, no doubt it will be one of the exports of the island, as there are thousands of tons under cultivation. I think if we had a few of our enterprising men to take this matter in hand it would pay handsomely.

STEAMERS.—I see from looking over the African papers, that there is an American line of steamers about to run between New York and the Cape of Good Hope, and I think if they could make a point of stopping here, on their passage to and from New York, it would be a great advantage to them, as everything in the vegetable line can be bought so much cheaper than at the Cape, and there would hardly be a trip that there would not be more or less freight.

WHALING SHIPS.—There is a large whaling fleet stopping here twice a year, and very often they have large quantities of oil to ship, and not only that, but there is a good sale of our American goods, more especially dress goods, salted provisions, and agricultural tools; our meat always receives a ready sale, and is much appreciated.

I have every reason to believe that in a very short time the island will be a free port to all shipping, as a memorial, signed by most of the inhabitants of the island, is about to be sent to H. M. Secretary for the Colonies, and, if successful, it will be of great benefit to all parties concerned, and I think it will be of immense importance to the larger class of our merchant vessels.

WATER.—Water is found in abundance and of the finest quality, and delivered to shipping very cheap; the hills abound in running streamlets of the purest. In fact, I don't think that any place on the globe is furnished with purer water than the little island of Saint Helena.

BUSINESS FIRM.—The principal business firm of the Island is the firm of Solomon, Moss, Gideon & Company, and as shipping has been falling off so much of late years they are the only parties left to do the shipping business, and they are generally reasonable in their charges and are willing to do everything in their power to increase trade.

H. J. CROUCH, U. S. Consul.

Consulate of the United States of America at Saint Helena, September, 1881.

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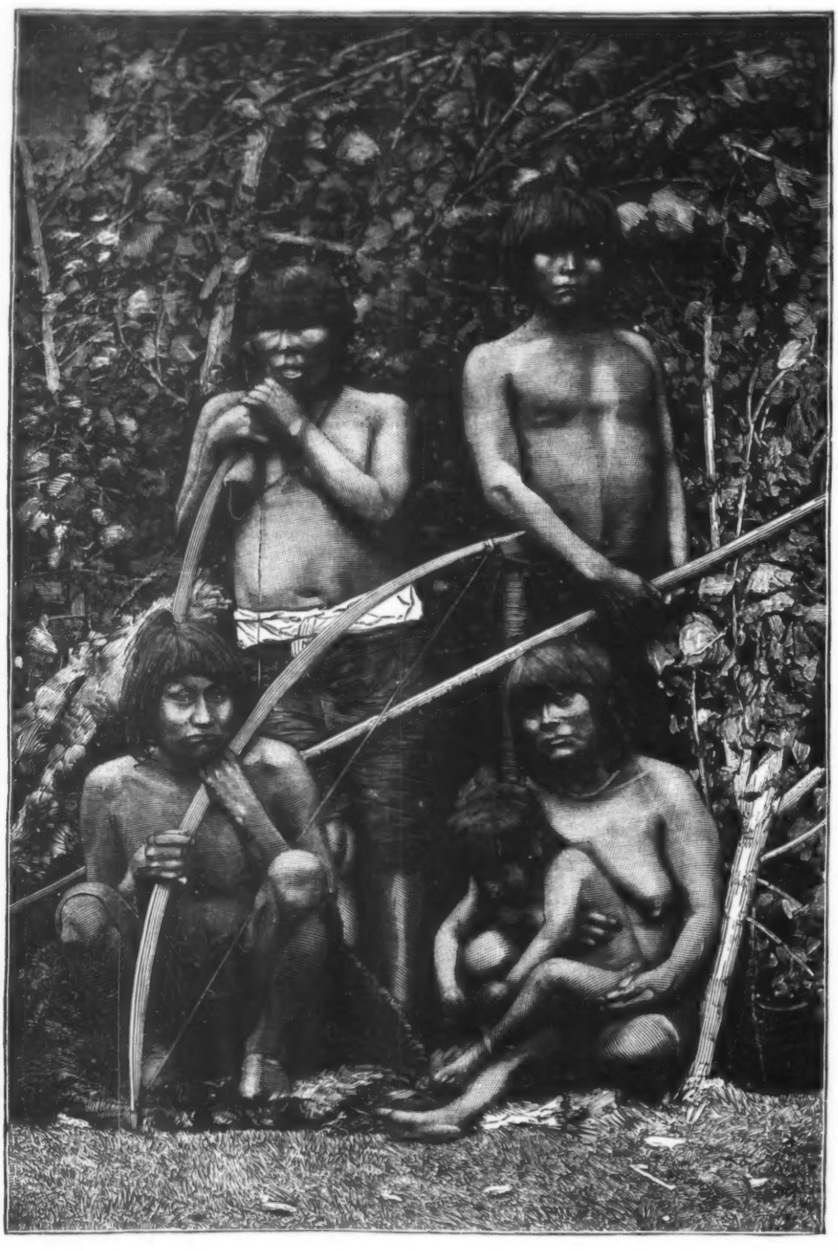
again, is the smoking of the drug so injurious a manner of introducing it into the system as the method of eating it or injecting it hypodermically.—*Times.*

THE FUEGIANS AT THE JARDIN D'ACCLIMATATION, PARIS.

FOR some time past there have been on exhibition at the Jardin d'Acclimatation, at Paris, a party of Fuegians, who have attracted great attention from visitors.

These Fuegians, for such is the name bestowed on them by Capt. Weddel in 1822—a name which has been preserved up to the present time—are inhabitants of Tierra del Fuego. When we read in the works of travelers a description of their country we are no longer surprised at the deep degradation of these people.

Tierra del Fuego is a mountainous archipelago, separated from Patagonia by the Strait of Magellan, and formed of enormous masses of precipitous rocks which leave only narrow beaches for man to dwell upon. In those portions where the rocks are not entirely bare, a thick and impenetrable forest of beech trees covers the sides of the mountains and descends to the ocean. No animal, save a few foxes and birds, inhabits this country. The climate is horrible; the mean summer temperature is, according to King and Darwin, 50° F., and that of winter, 33° F.; there is a perpetual fog, and storms are incessant. There scarcely passes a day that it does not rain, or even snow. To find an acre of level land in any part of the country is very rare; the fact is, Tierra del Fuego is a mountainous land partly submerged in the sea, so that deep inlets and bays occupy the place where valleys should exist.



GROUP OF FUEGIANS AT THE JARDIN D'ACCLIMATATION, PARIS. (From a Photograph.)

The Fuegians have long been known and have been many times described. We borrow from D'Orbigny the description that he gives of them, and which is said by *La Nature*, to which we are indebted for the accompanying engraving, to apply perfectly to the savages now on exhibition in Paris.

Their head, says this author, is pretty big, and their face rounded; they have a short and slightly expanded nose, and small, black, horizontal eyes; their mouth is large, with thick lips, and their very even teeth are white; their ears are small, and their cheek-bones project but slightly. They have but a slight beard, which it is their habit to pluck out. Their hair, like that of all Americans, is black, long, and straight. Their body is thick-set, their breast is broad, and their bowed legs relatively quite short. The women exhibit the same characters as the men, and scarcely possess those proportions that European æsthetics require. Their average height is about 5¼ feet. Their language is guttural, and has been compared by Capt. Cook to the sound emitted by a person clearing his throat.

The great naturalist, Charles Darwin, was enabled, during the several months that he passed in their country, to observe their habits, and has given us a picture which, because of its truthfulness, is none the less attractive. From him we borrow the following details:

These people, divided into different tribes, have no government nor chief; yet each is surrounded by other hostile tribes, speaking different dialects, and separated from each other only by a deserted border or neutral territory; the cause of their warfare appears to be the means of subsistence. The habitable land is reduced to the stones on the beach; in search of food they are compelled unceasingly to wander from spot to spot, and so steep is the coast, that they can only move about in their wretched canoes. They cannot know the feeling of having a home, and still less that of domestic affection, for the husband is to the wife a brutal master to a laborious slave.

Their skill in some respects may be compared to the instinct of animals, for it is not improved by experience; the canoe, their most ingenious work, poor as it is, has remained the same, as we know from Drake, for the last two hundred and fifty years.

The Fuegian wigwam resembles, in shape and dimensions, a haycock. It consists merely of a few broken branches stuck in the ground, and very imperfectly thatched on one side with a few tufts of grass and rushes. The whole cannot be the work of an hour, and it is only used for a few days. On the west coast the wigwams are better, for they are covered with sealskins. On the east coast the native's only garment consists of a mantle made of guanaco skin, with the wool outside, which they wear just thrown over their shoulders, leaving their persons as often exposed as covered. Their skin is of a dirty coppery-red color. On the west coast they wear sealskins. Among the central tribes, the men generally have an otter-skin, or some small scrap about as large as a pocket handkerchief, which is barely sufficient to cover their backs as low down as their loins. It is laced across the breast by strings, and according as the wind blows, it is shifted from side to side.

At night, five or six human beings, naked and scarcely protected from the wind and rain of this tempestuous climate, sleep on the wet ground coiled up like animals. Whenever it is low water, winter or summer, night or day, they must rise to pick shell-fish from the rocks; and the women either dive to collect sea-eggs, or sit patiently in their canoes and with a baited hair-line without any hook, jerk out little fish. If a seal is killed or the floating carcass of a putrid whale is discovered, it is a feast; and such miserable food is assisted by a few tasteless berries and fungi. When pressed in winter by hunger, they kill and devour their old women before they kill their dogs, because, as they say, dogs catch otters but old women do not.

It has never been ascertained that the Fuegians have any distinct belief in a future life. They sometimes bury their dead in caves, and sometimes in the mountain forests; but it is not known what, if any, ceremonies they perform.

While beholding these savages, one asks whence have they come? What could have tempted, or what change compelled a tribe of men to leave the fine regions of the north to travel down the Cordillera or back-bone of America, to invent and build canoes, which are not used by the tribes of Chili, Peru, and Brazil, and then to enter on one of the most inhospitable countries within the limits of the globe? Although such reflections must at first seize on the mind, yet we must feel that they are partly erroneous. There is no reason to believe that the Fuegians decrease in number, therefore we must suppose that they enjoy a sufficient share of happiness to render life worth living.

The perfect equality among the individuals composing the Fuegian tribes, says Mr. Darwin, must for a long time retard their civilization. In Tierra del Fuego, until some chief shall arise with power sufficient to secure any acquired advantage, such as the domesticated animals, it seems scarcely possible that the political state of the country can be improved. At present, even a piece of cloth given to one is torn into shreds and distributed; and no one individual becomes richer than another. On the other hand it is difficult to understand how a chief can arise till there is property of some sort by which he can manifest his superiority and increase his power.

The Fuegians in Paris, eleven in number (four men, four women, and three children) were brought thither by Mr. Waalen, after depositing some three thousand dollars in the hands of the Chilian Governor of Punta-Arenas as a security for their safe return to their native land after being exhibited throughout Europe.

SOAP AND ITS MANUFACTURE FROM A CONSUMER'S POINT OF VIEW.

SOME practical study of the subject of soap by its numerous consumers, either those who use it simply for family use, or consume it for other purposes on a more extended scale, will well repay the time and attention devoted to this purpose. We propose to give some practical information on the subject, together with a few facts for the consideration of our readers, believing that it will prove of general interest.

Many people fancy that there is really but little practical difference between the various qualities of soap sold to the public, and they consequently purchase the cheapest article they can get. Nothing could be a greater mistake. This is an age of *adulteration* in almost every article offered to the public. It has been forced on by their almost insatiable demand for *cheap* things; and perhaps in the whole range of manufactured articles sold in this country, no one article has been more extensively adulterated than soap. Both manufacturers and dealers have found the adulterated article more profitable to produce and handle than a genuine soap, as they have taken care that in satisfying the demand from the public for a *cheap* soap, at the same time to secure an extra profit for themselves by cheapening it further than was necessary! The result of this is that all kinds of substances are put in wholesale into soap simply to effect this object. China clay, silex, starch, rosin, silicate of soda (this latter a mixture of sand and soda, forming a kind of soluble glass, which hardens the soap and yet allows of an enormous amount of water being added), are all largely used for the adulteration of soap.

Now a pure soap is simply and solely a combination of tallow, grease, and oil, with either pure caustic soda or caustic potash, with a proper proportion of water necessary to effect saponification. In the case of a pure soap, it should contain about sixty per cent. of tallow or oil, ten per cent. of pure caustic soda, and thirty per cent. of water. It is an undoubted fact, however, that with all the soaps sold in this country to the public, not a single one of them fulfills these conditions. They are all, without exception, more or less adulterated.

Consumers are not generally aware that the most expensive article to the soap boilers is the oil, grease, or tallow used in the production of his soap. This is, however, four-fifths of the cost of every *pure* soap, the caustic soda only amounting to one-fifth of its value. The whole aim of the soap boiler, who makes a soap to *sell*, is to cut down the tallow in the soap, either by the substitution of water combined with starch, silicate of soda, or sal soda, which are, so to speak, the carriers of water in the soap, or such cheap articles as rosin, china clay, and silex, which simply make weight, are added. It must be confessed that the process of using and at the same time hiding these adulterants from the eye of the general consumer, has been carried to great perfection, and it is only to be regretted that the skill and ingenuity that has been developed in this line has not been employed in a worthier cause. Very few soaps that are sold contain forty per cent. of tallow or oil; twenty per cent. of tallow really is a fair average, as many soaps do not even contain this, that is to say, on an average they contain full sixty per cent. of adulteration.

Now the effect of these impurities causes either one or all of these three things. *First:* Double or treble the quantity of soap as compared with a pure soap, has to be used. *Secondly:* The articles washed with these impure soaps are injured, either by the injurious action of these impurities, or by the extra rubbing or working in the washing machine, necessarily requisite to make the impure soap do its work. *Thirdly*, and to many poor women the most important item, the washing day, is dreaded, as the various impurities act terribly on the skin, and the result is either bleeding hands, or, at any rate, an injured skin.

There is another point that shall just be touched upon as little as possible, as the subject is very unpleasant. In some of the British newspapers, published not long ago in London, there was quite a discussion as to the origin of various skin diseases and blood poisoning. Some of the most eminent London surgeons, who have made the subject of skin diseases their special study, did not hesitate to affirm